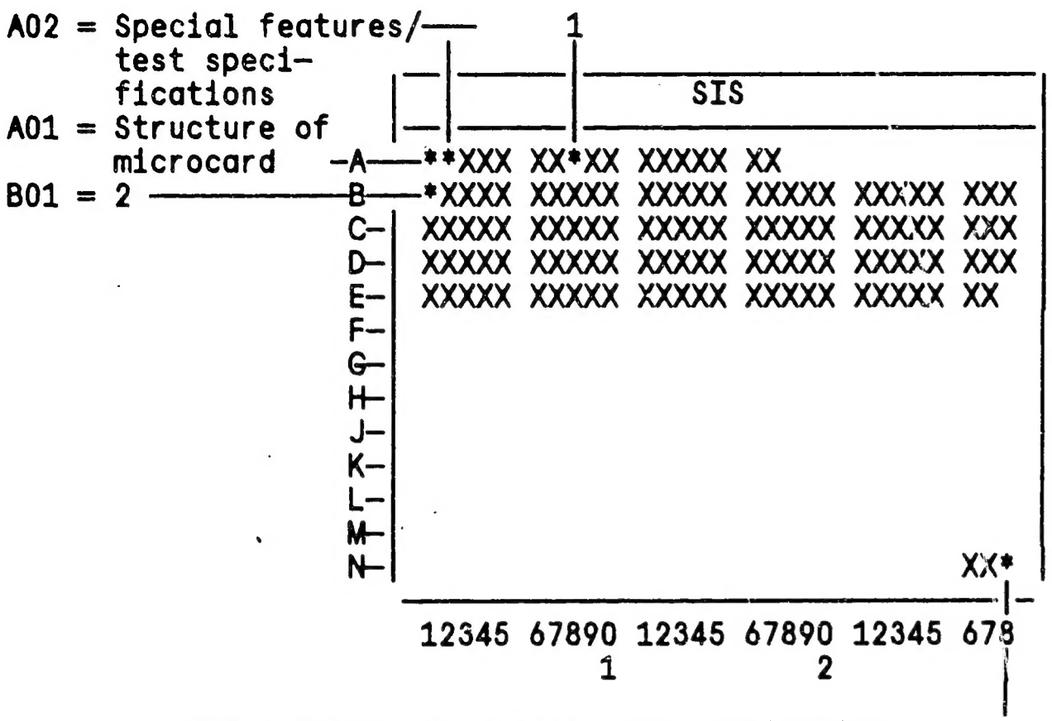
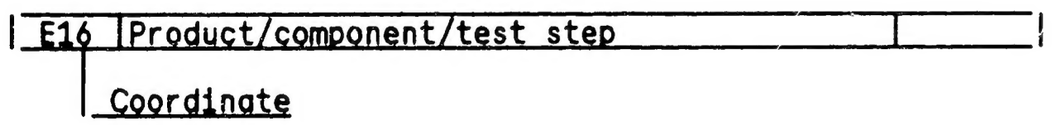
STRUCTURE OF THE MICROCARD



N28 = Table of contents and publication information
1 = Tools and devices
2 = Complete instructions, divided into test steps (no references)

a. Read from left to right.

b. Title of micropicture (appears on each coordinate).



c. Limits of section

SPECIAL FEATURES

Repair instructions for in-line pumps of series PE..ZW(M)..S 2000/S 3000 without governor, LDA (manifold-pressure compensator) and timing device. Please refer to the respective repair instructions for information on how to repair the various governors.

TEST SPECIFICATIONS

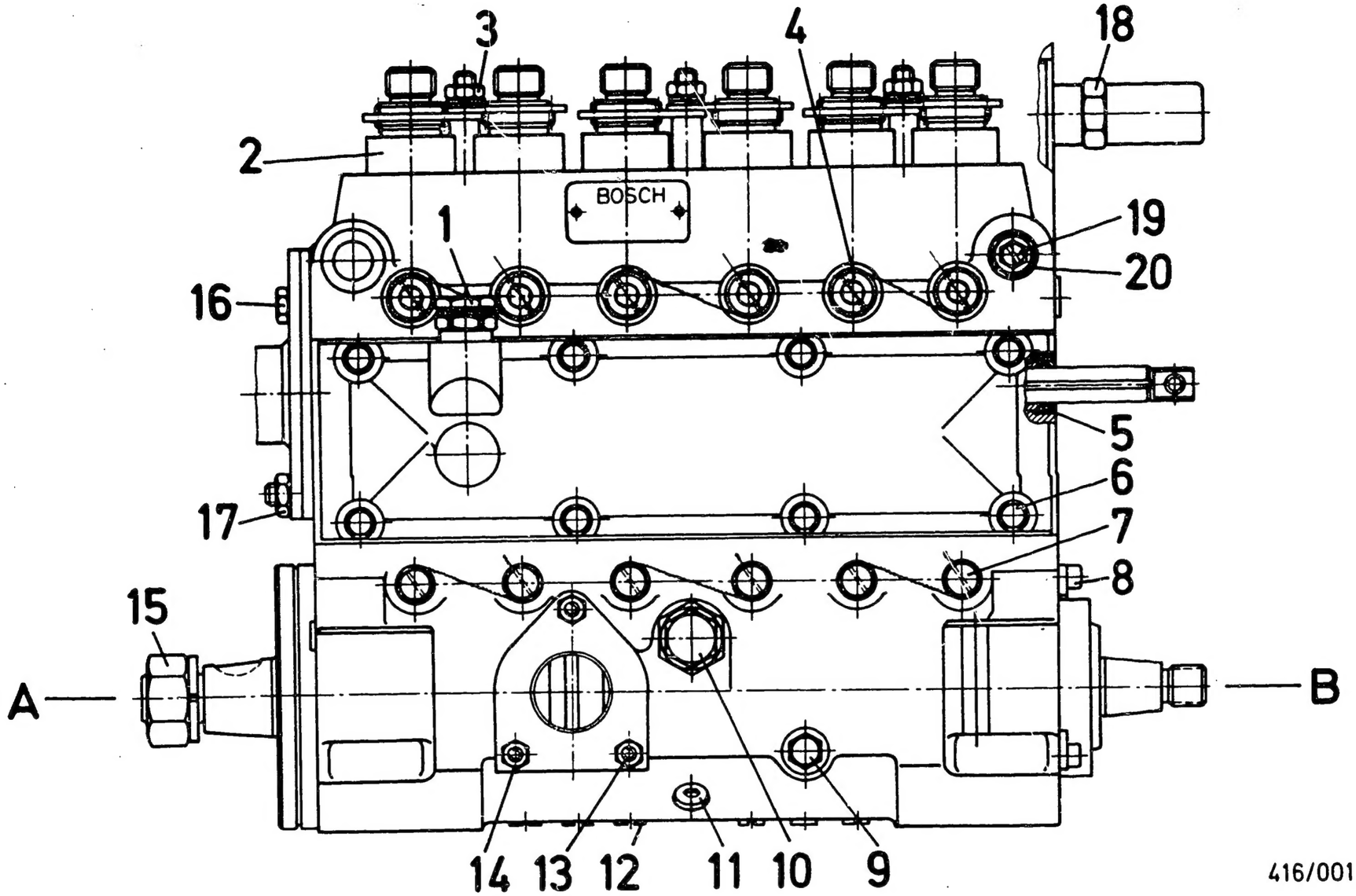
Projection of camshaft, top edge of measuring tool to pump housing
Set value: 90 +/- 0.2 mm

Axial clearance of camshaft
Tapered-roller bearing Set value: 0.02...0.06mm

Leak test (suction gallery)
Test duration and test pressure:
min. 1 minute at 5 bar

Leak test (camshaft chamber etc.)
Test duration and test pressure:
30 min. at 5 bar, then
30 min. at 0.5 bar

Tightening torques
Bolts, nuts etc. are indicated on the drawing as of Coordinate A03.
These items are repeated after every drawing and the tightening torque is given.



416/001

TIGHTENING TORQUES

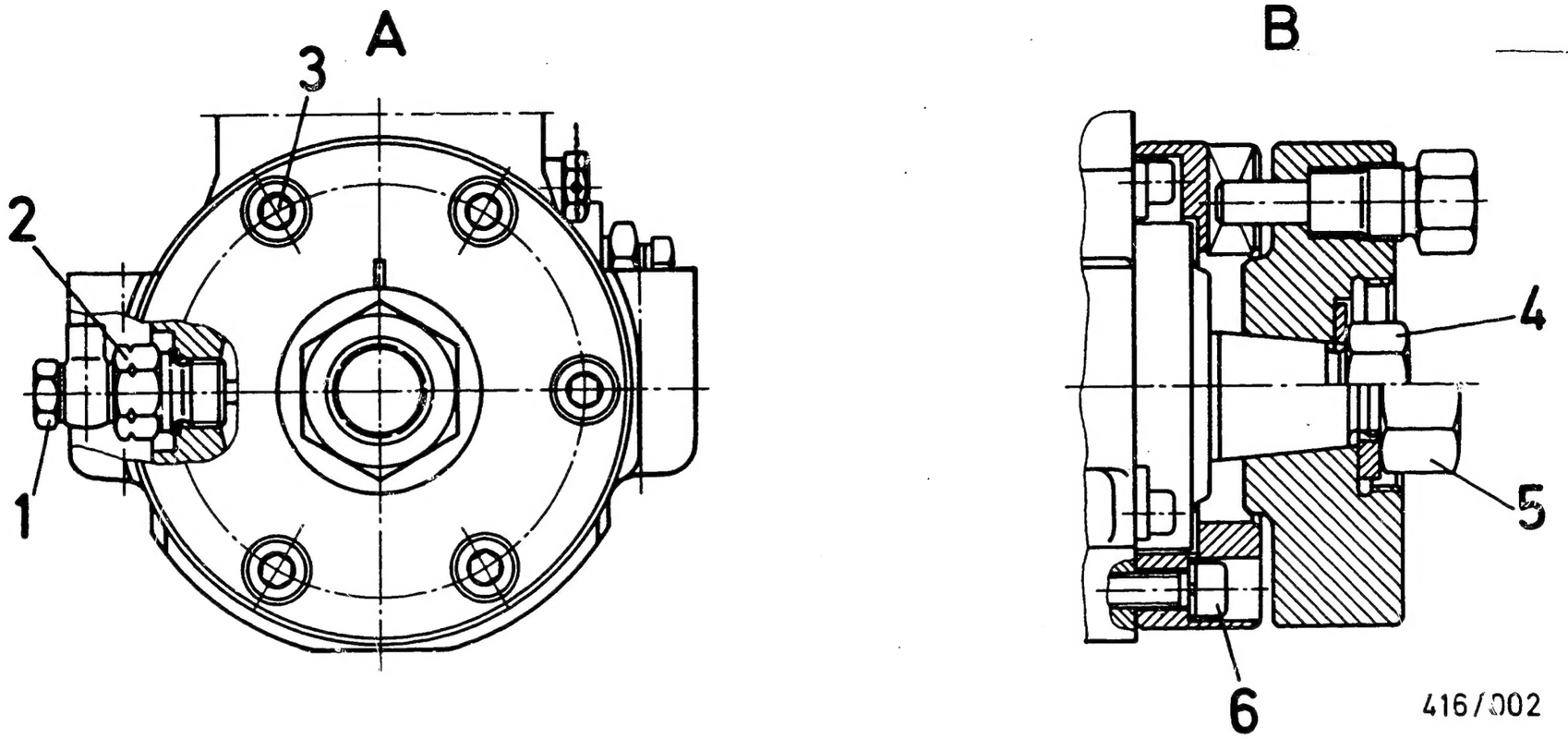
Refer to following Coordinates for values.

TIGHTENING TORQUES

Item No	Designation	Torque (Nm)
1	Screw plug	25...42
2	Del.-vlv. hold. with polyamide seal ring Del.-vlv. hold. up to code no. S 2999 Del.-vlv. hold. as of code no.	90–0–90...95 100–0–90...95 200–0–190...200
3	Nut	11...15
4	Baffle screw Hexagon socket Hexagon bolt M 10 M 14	40...50 25...30 40...45
5	Control-rod guide bushing	4...6
6	Hexagon bolt	4...6
7	Guide screw	17...20
8	Bearing-end-plate fastening screw	6...8
9	Screw plug	14...16
10	Hexagon bolt	25...42
11	Bearing-shell fastening screw	20...24
12	Flat-head screw	4...5
13	Hexagon nut	5...7
14	Threaded pin	3...4

TIGHTENING TORQUES (CONTINUED)

Item No.	Designation	Torque (Nm)
15	Hexagon nut Cone dia. 30 mm Cone dia. 35 mm Cone dia. 45 mm	 200...240 250...300 400...450
16	Hexagon bolt	8... 10
17	Hexagon nut	10... 16
18	Union nut	20... 30
19	Hexagon bolt	4... 5
20	Inlet-union screw	20... 30



TIGHTENING TORQUES (CONTINUED)

It.No.	Designation	Torque (Nm)
1	Inlet-union screw	8...12
2	Lubricator M 15x1.5 M 18x1.5	40...50 45...55
3	Bearing-end-plate fastening screw M 6 M 8	 15...18 20...24

It.No.	Designation	Torque (Nm)
4	Fastening nut Cone dia. 25 mm	200...225
5	Fastening nut Cone dia. 35 mm	200...225
6	Hexagon-socket-head cap screw	20... 24

TIGHTENING TORQUES (CONTINUED)

Item No.	Designation	Torque (Nm)
	Clamping screw (gear segment)	5...6
	Governor fastening screws:	
	-flat-head screw	13...18
	-hexagon bolt	18...20
	-capstan screw	5...7
	-hexagon nut	18...20
	-Torx bolt	13...18
	Base-cover screw	110...120

GENERAL

* Worn or damaged components and sealing elements are always to be renewed.
* If fuel-injection-pump components are to be stored for a lengthy period, then they should be covered and protected against rust.
* Leak test on governor chamber:
  In order to avoid possible skin irritation when immersing hands in test bath, apply handcream beforehand and wash hands with soap and water following completion of test.
* Cleaning of parts:
  Wash out parts in commercially available cleaning agent, e.g. chlorothene NU, which is not readily flammable.
  Then blow out with compressed air.
* Safety precautions to be observed when handling combustible liquids:
  Order Governing Work Involving Combustible Liquids (Vbf) as issued by the Federal Labor Ministry (BmA).
  Safety regulations when handling chlorinated hydrocarbons:
  - for companies ZH 1/222
  - for employees ZH 1/129
  as published by the Hauptverband für Gewerbliche Berufsgenossenschaften (Zentralverband für Unfallschutz und Arbeitsmedizin) Langwartweg 103
  5300 Bonn 5, West Germany.
  Outside West Germany the corresponding local regulations are to be observed.

TOOLS AND DEVICES

Designation	Part No.	Use
Clamping support Holding pieces Shaft for clamping support	KDEP 2919 KDEP 2898 KDEP 2919/1/13	Clamping ZWM pump
Tappet holder up to ZWM/..S 2999 as of ZWM/..S 3000	 KDEP 1621 KDEP 1534	Locking tappet
Puller	e.g. Hahn & Kolb 55030 020	Removing bearing end plate
Screwing tool	KDEP 1072	Screwing in and unscrewing base-cover screws
Mounting sleeve Cone dia. 25mm Cone dia. 30mm Cone dia. 35mm Cone dia. 40mm Cone dia. 45mm	 KDEP 2925 KDEP 1502 KDEP 2869 on request on request	Mounting radial-lip-type oil seals
Clamping fixture up to ZWM/..S 2999 as of ZWM/..S 3000	 KDEP 1536 KDEP 1535	Pressing up roller tappet
Tappet forceps	KDEP 2917	Assembling/disassembling roller tappet
Serrated wrench	KDEP 2920	Assembling/disassembling delivery-valve assemblies
Holding wrench Cone dia. 30mm Cone dia. 35mm	 KDEP 2885 KDEP 1555	Holding camshaft against coupling half
Hand cutter up to ZWM/..S 2999 as of ZWM/..S 3000	 KDEP 2958 KDEP 1653	Reworking seats for plunger-and-barrel assemblies

Tools and devices (continued)

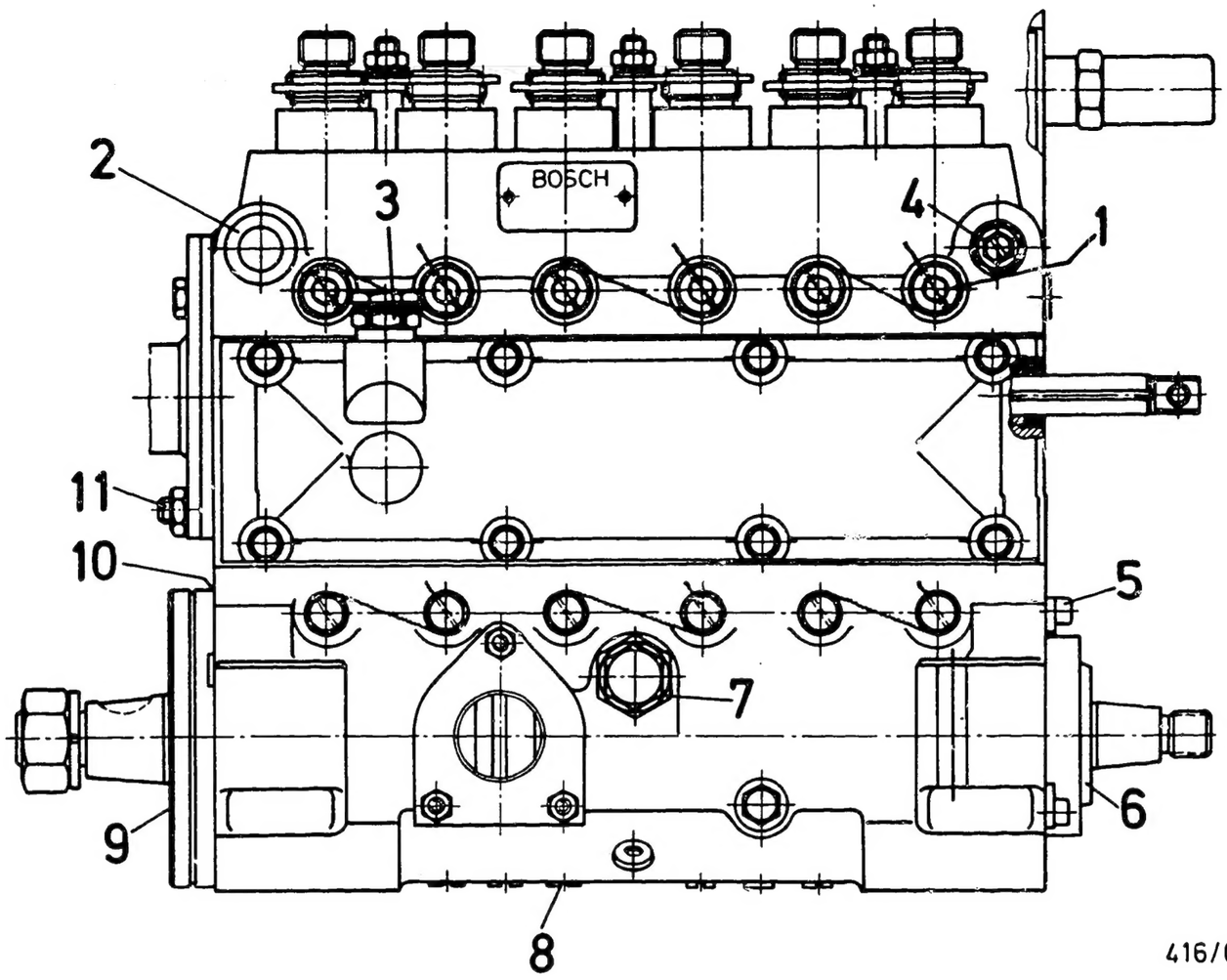
Designation	Part No.	Use
Reamer	KDEP 1622	Reaming control-rod guide bushing
Plunger grippers up to S 2999 as of S 3000	 KDEP 2942 KDEP 1623	Installing and removing pump plunger
Measuring sleeve Cone dia. 30mm Cone dia. 35mm Cone dia. 40mm Cone dia. 45mm	 KDEP 1656 KDEP 1657 on request on request	Testing installation position of camshaft
Measuring tool Cone dia. 30mm Cone dia. 35mm Cone dia. 40mm Cone dia. 45mm	 KDEP 2882 KDEP 2889 on request on request	Testing axial clearance of camshaft
Screwdriver	KDEP 2970	Screwing in and unscrewing slotted round nut of control-rod guide bushing
Clamping fixture up to S 2999	 KDEP 1625	Clamping plunger return spring
Tweezers up to S 2999	 KDEP 1626	Removing/inserting prestroke disk
LPC adjusting device up to S 2999 as of S 3000	 1 688 130 033 1 688 130 182	Adjusting/testing prestroke
Dial indicator A DIN 872	1 687 233 011	Measuring prestroke/camshaft axial clearance
Release plate	KDEP 1580	Releasing camshaft bearing

Tools and devices (continued)

Designation	Part No.	Use
Pressing-on sleeve Cone dia. 25mm Cone dia. 30mm Cone dia. 35mm Cone dia. 40mm Cone dia. 45mm	 KDEP 1594/3 KDEP 1583 KDEP 1559 on request on request	Pressing on camshaft bearing
Coupling half Cone dia. 30mm Cone dia. 30mm Cone dia. 35mm Cone dia. 35mm Cone dia. 40mm Cone dia. 45mm	 1 686 430 034 1 686 430 012 1 686 430 019 1 686 430 035 1 686 430 013 on request	Cranking camshaft (EPS 675) (EPS 675) (EPS 675)
Internal extractor Counter-support	e.g. Hahn & Kolb 55 105 55 106	Removing bearing outer races
Mounting tool as of S 3000	KDEP 1652	Mounting plunger return springs and control sleeves
Puller	KDEP 1650	Removing setting ring (FBG setting)
Extractor	KDEP 1056	Removing control-rod guide bushings
Sleeve	KDEP 1654	Guiding extractor (control-rod guide bushings)
Mounting tool as of S 3000	KDEP 1651	Removing/installing base cover
Drive mandrel	KDEP 1655	Driving in control-rod guide bushings

Tools and devices (special tools)

Designation	Part No.	Use
Directional-control valve	KDJE-P 100/1	Testing suction gallery
Spring set	KDEP 2917/0/3	Fitting/removal of roller tappet
Long bushing	KDEP 2919/1/14	Locking of top part of clamping support
Intermediate piece	KDEP 2898/2/7	Moving support to outside



416/003

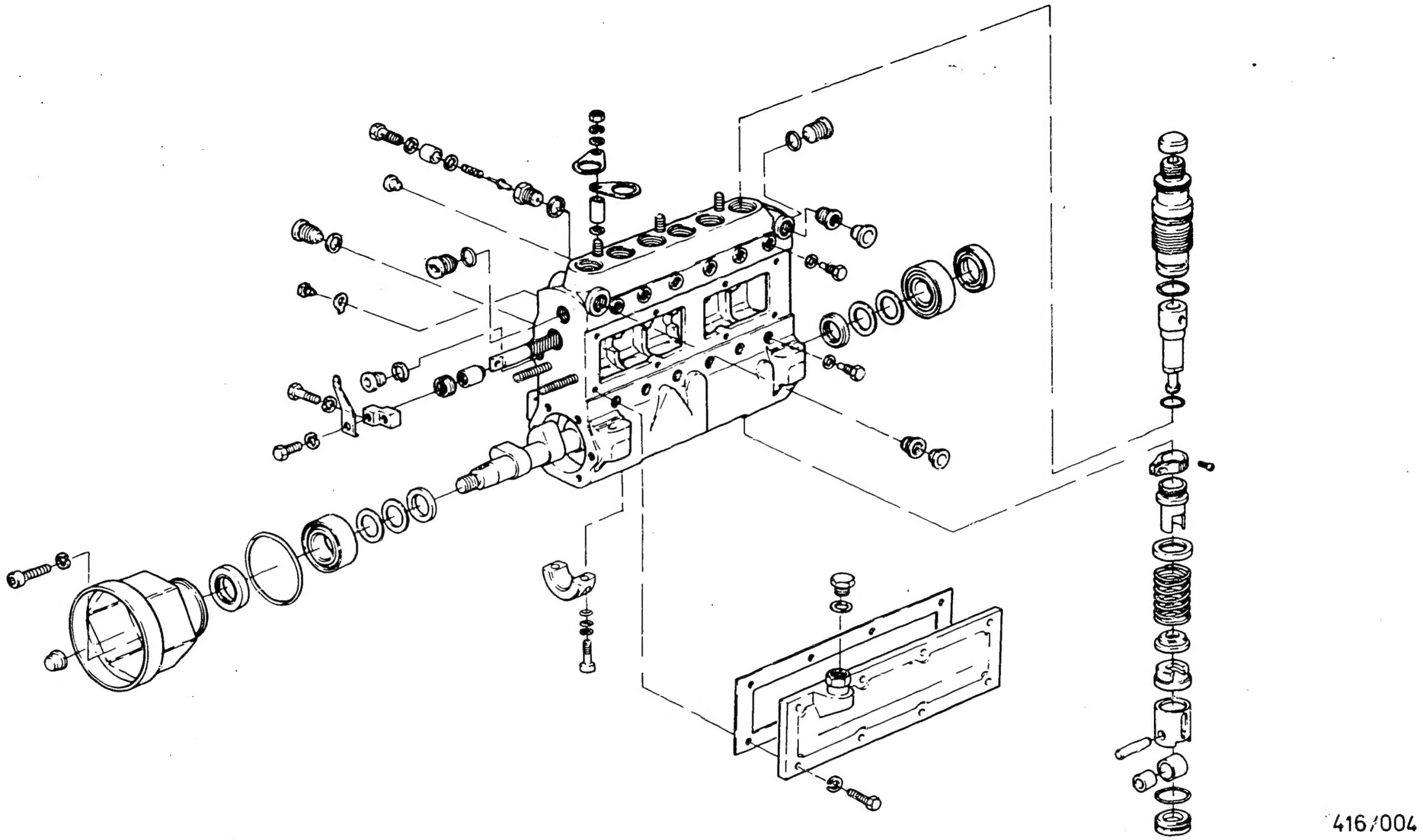
SEALING AND BONDING POINTS

Refer to following Coordinates for description.

SEALING AND BONDING POINTS, MATERIAL DESIGNATION
LUBRICANTS

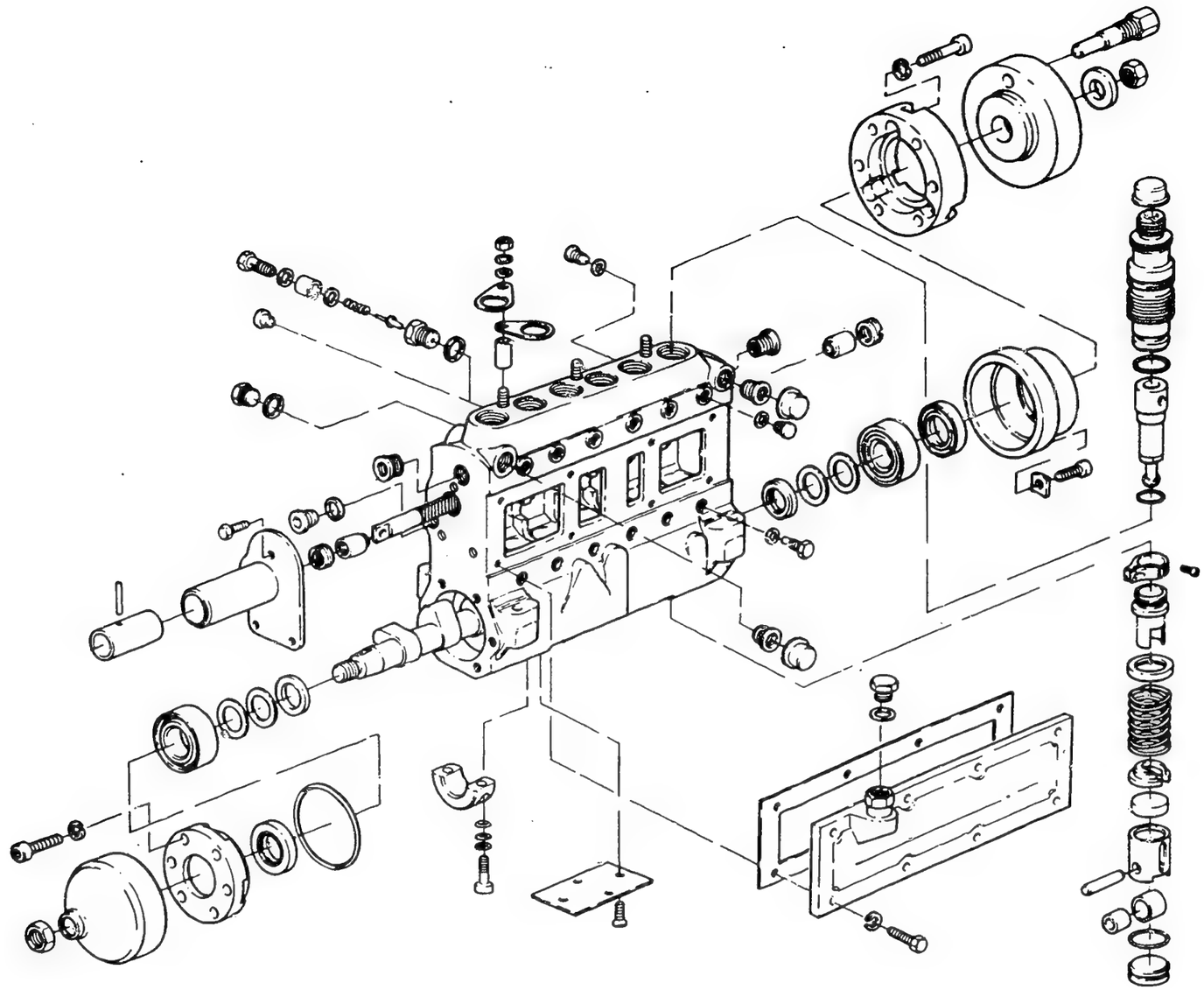
No.	Part Designation	Tradename	Qty.	Part No.
1	Baffle screw	Surface sealing compound	Jar 50 g	5 970 100 512
2	Threaded bushing	Epoxy resin	50 ml	5 703 348 005
		hardener	50 ml	5 707 567 005
3	Threaded bushing	Epoxy resin	50 ml	5 703 348 005
		hardener	50 ml	5 707 567 005
4	Threaded bushing	Epoxy resin	50 ml	5 703 348 005
		hardener	50 ml	5 707 567 005
5	Hexagon bolt	Epoxy resin	50 ml	5 703 348 005
		hardener	50 ml	5 707 567 005
6	Radial-lip-type oil seal	Talc		Commercially available
		High-temp-erature grease	Jar 45 ml	5 700 002 005
			225 ml	5 700 002 025
7	Threaded bushing	Epoxy resin	50 ml	5 703 348 005
		hardener	50 ml	5 707 567 005
8	Flat-head screw	Epoxy resin	50 ml	5 703 348 005
		hardener	50 ml	5 707 567 005
9	Radial-lip-type oil seal	Talc		Commercially available
		High-temp-erature grease	Tube 45 ml	5 700 002 005
			225 ml	5 700 002 025
10	Bearing end plate	Surface sealing compound	Jar 50 g	5 970 100 512
11	Set screw	Epoxy resin	50 ml	5 703 348 005
		hardener	50 ml	5 707 567 005

For production reasons:
continued on the following coordinate.



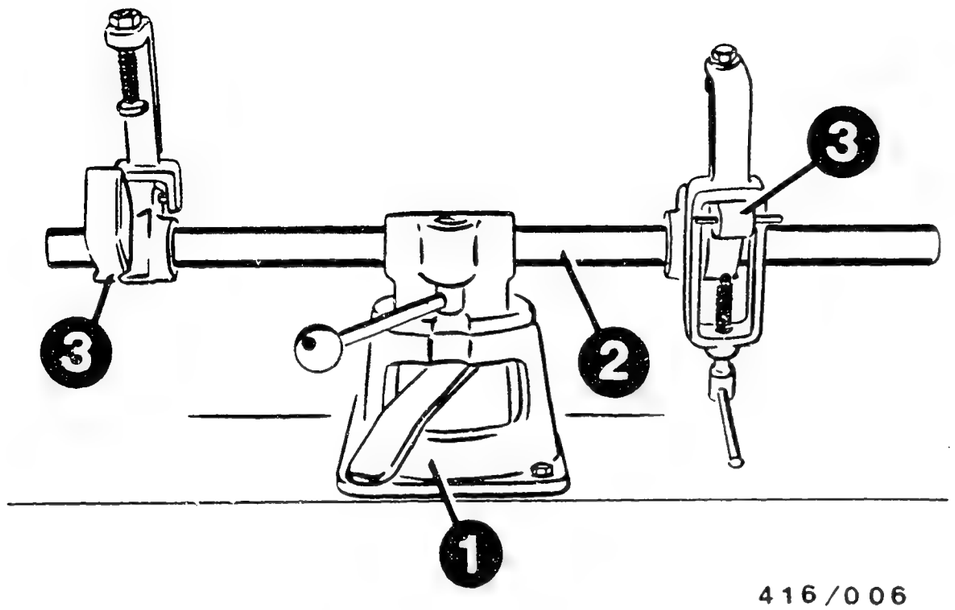
416/004

Exploded view up to series S 2999



416/005

Exploded view as of series S 3000

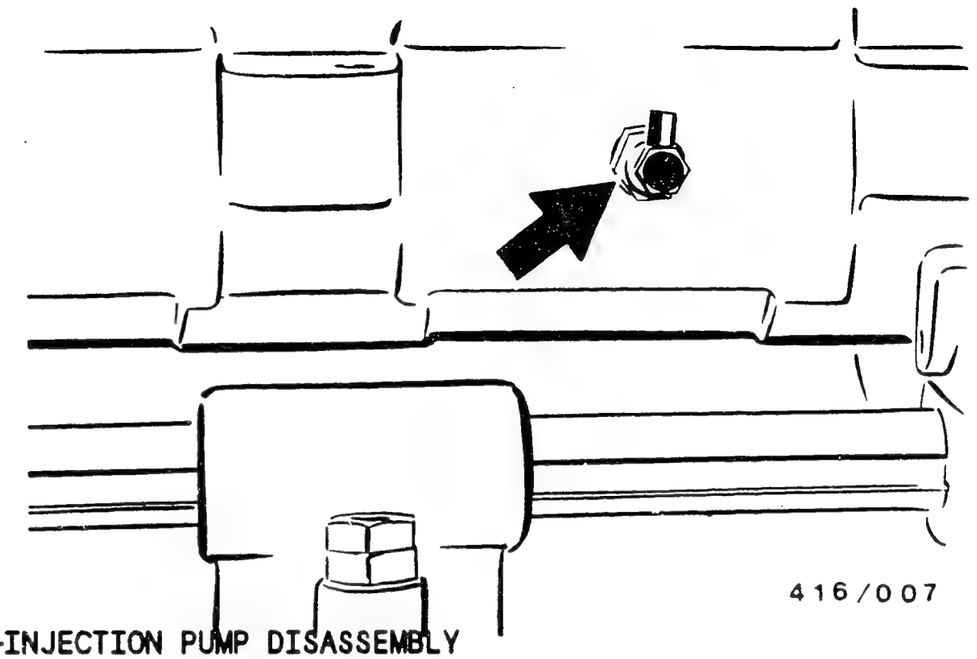


416/006

1 = Clamping support KDEP 2919
2 = Shaft for clamping support KDEP 2919/1/13
3 = Holding pieces KDEP 2898

CLAMPING FUEL-INJECTION PUMP

The clamping device shown in the picture is required for clamping the fuel-injection pump.



416/007

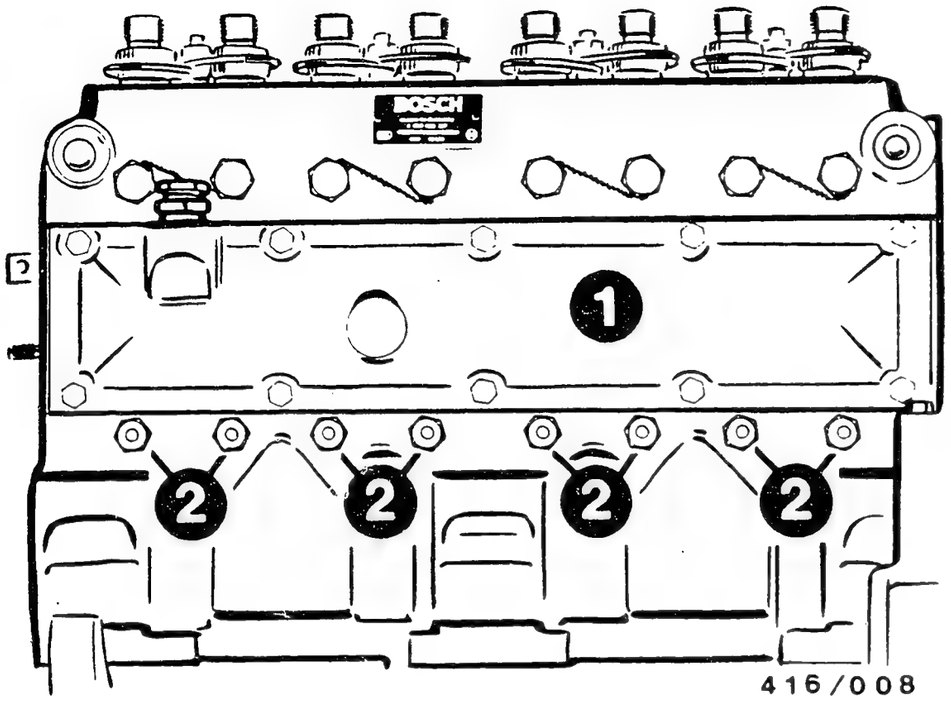
FUEL-INJECTION PUMP DISASSEMBLY

Remove fitted drive components (multi-plate clutch, toothed gear or timing device) using suitable tools.

Attach driving coupling in line with cone diameter of camshaft stub and secure it.

Disassemble governor in line with respective repair instructions.

Remove lubricator (picture, arrow).

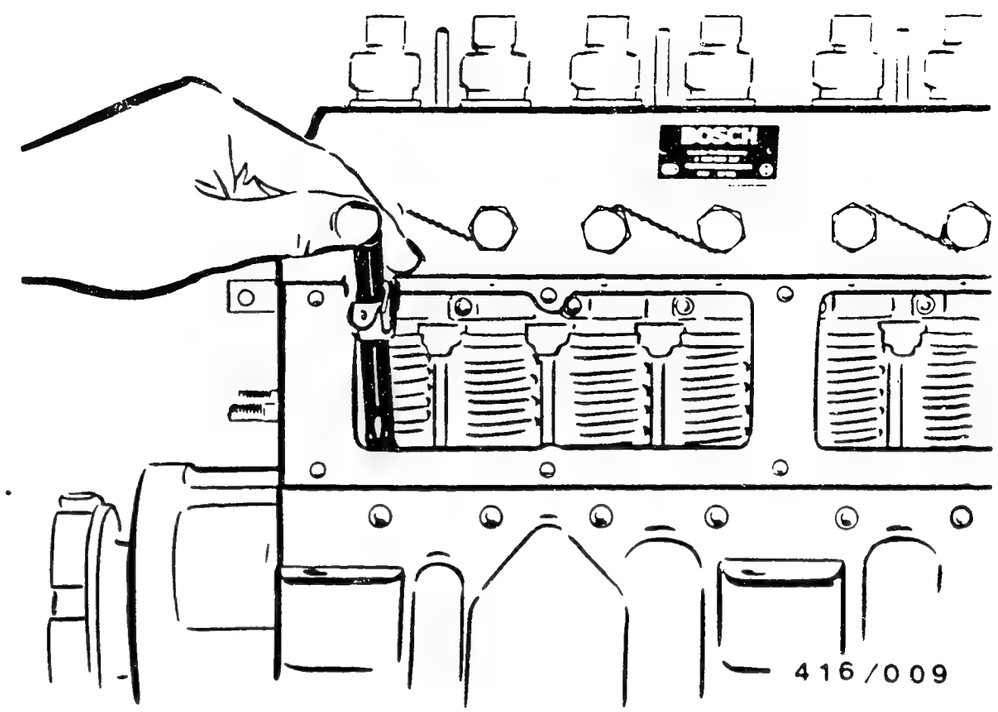


1 = Closing cover
2 = Roller-tappet guide screw

Remove closing cover and, if applicable, supply pump.

Unscrew roller-tappet guide screws.

Note:
Depending on size of fuel-injection pump, have sufficient boxes available for accommodating components.



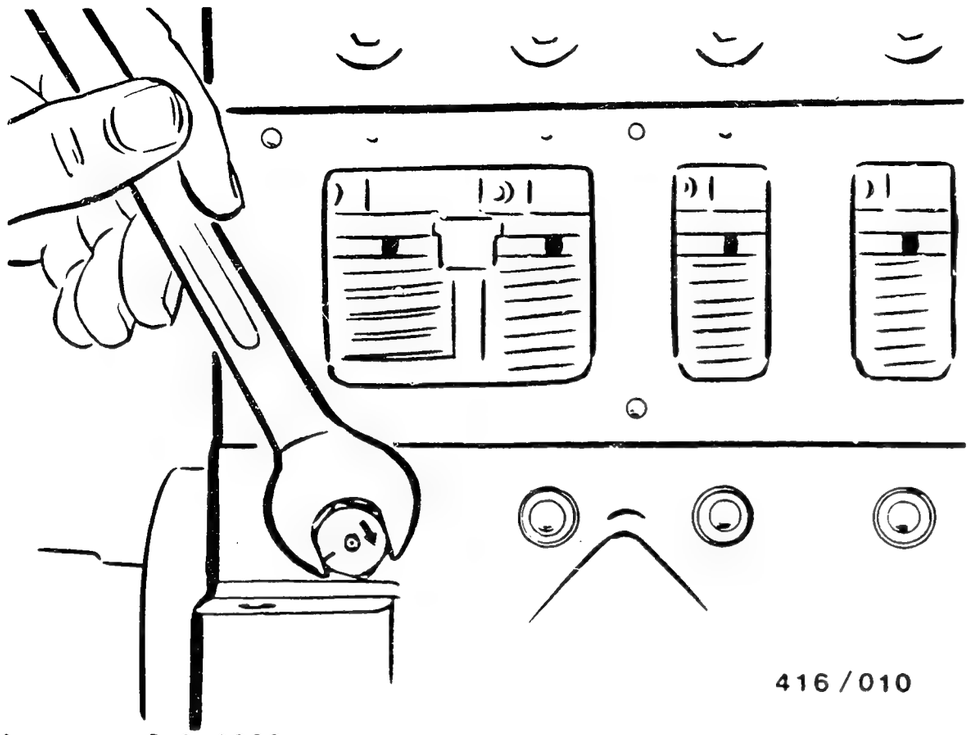
Series up to S 2999

Turn camshaft with holding wrench and position roller tappet with tappet holder KDEP 1621 in TDC position of respective cam.

Fit tappet holder such that lug of holder engages in hole on side of roller tappet.

Press lever down. Support safety catch at upper closing-cover pilot. Camshaft must turn without making contact with roller tappet.

Note:
Do n o t lift roller tappet with tappet holder (without aid of cam); lug of tappet holder may break off.



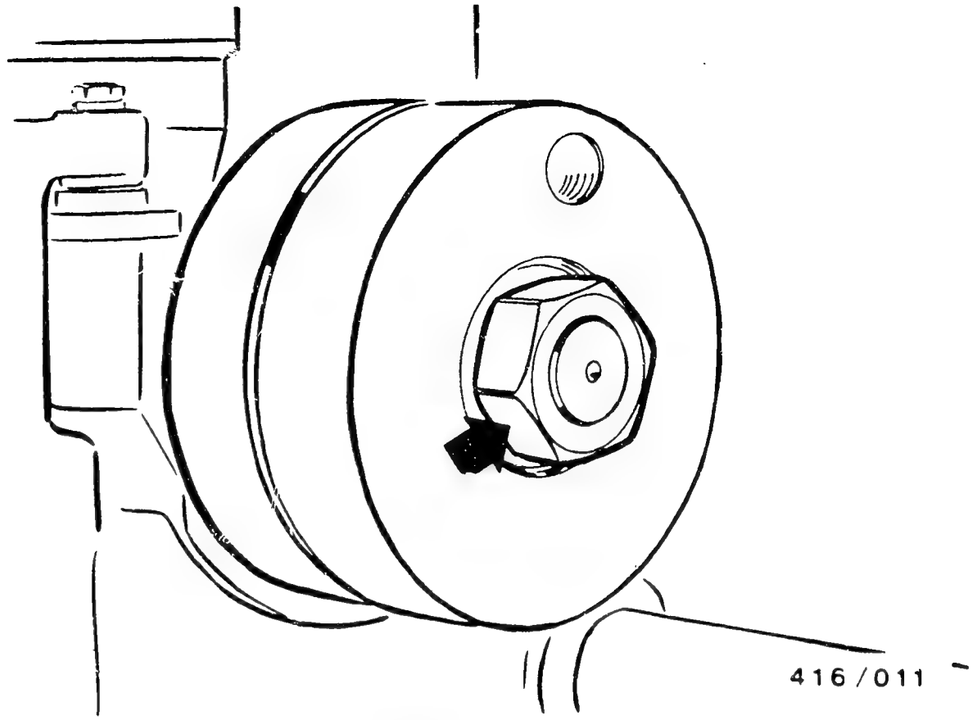
Series as of S 3000

Turn camshaft with holding wrench and position roller tappet with tappet holder KDEP 1534 in TDC position of respective cam.

Loosen lock nut at tappet holder such that contact surface of eccentric makes contact with end of thread.

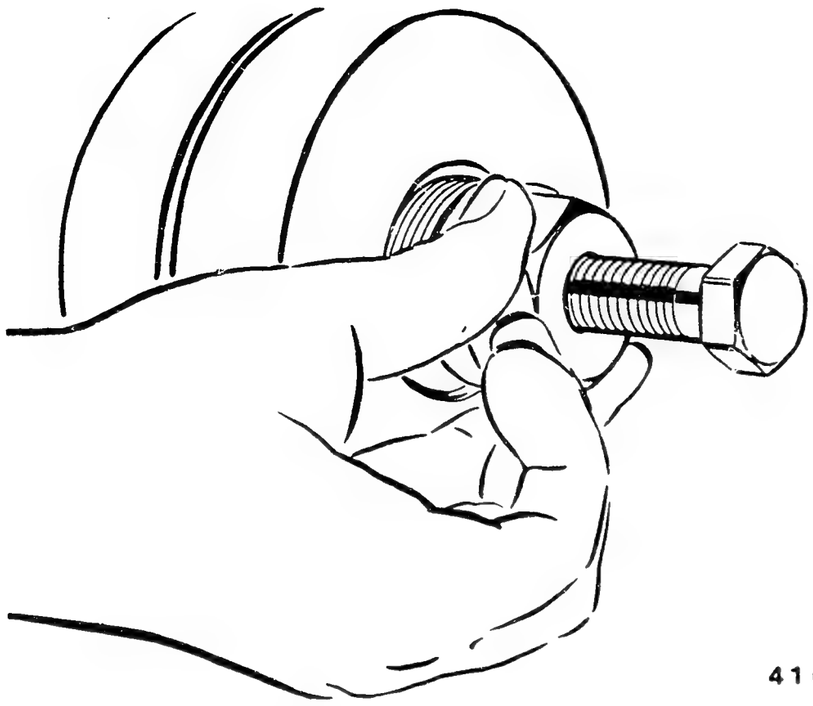
Screw in tappet holder taking care to position mark on drive hexagon vertically downwards. Secure tappet holder.

Move drive hexagon approx. 1/4 of a turn in direction of arrow until roller tappet has lifted off cam (caution! excessive turning of eccentric damages tool and roller tappet).



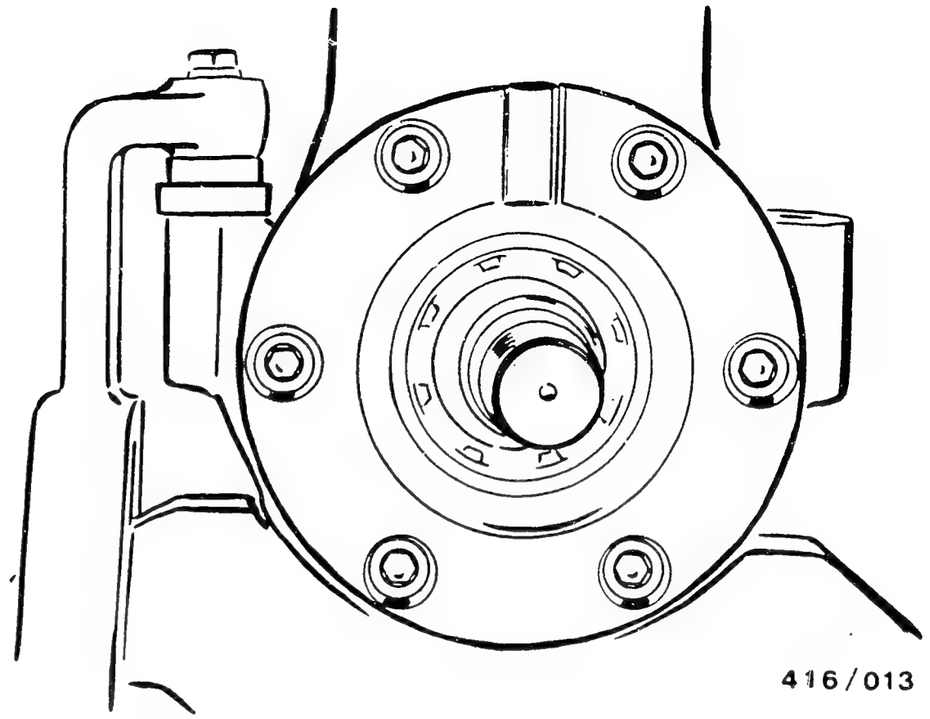
Series up to S 2999 and S 3000

Unscrew fastening nut whilst counter-holding with holding wrench at driving coupling (picture, arrow).



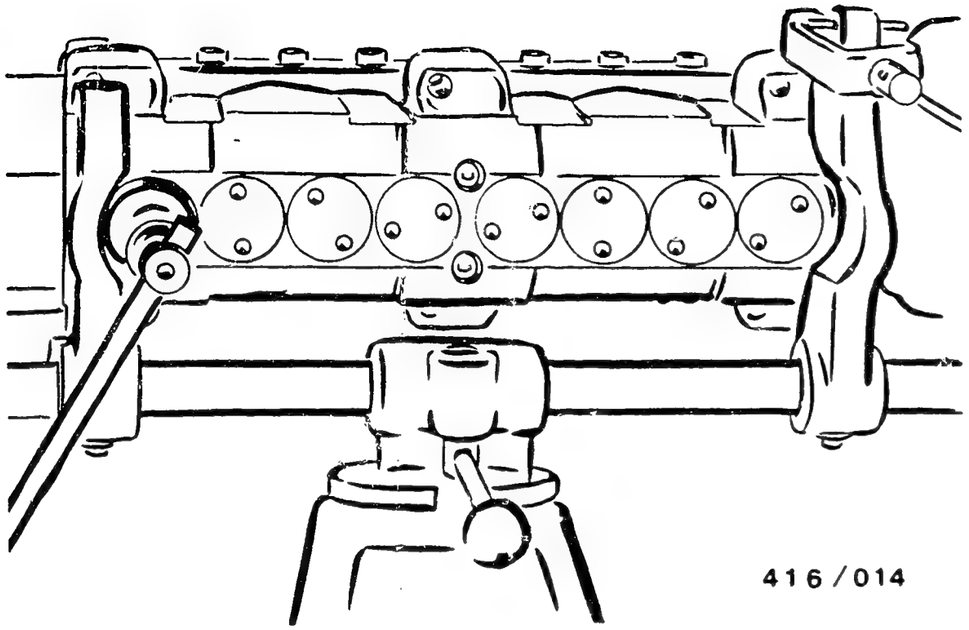
416/012

Use puller KDEP 1650 to remove driver from stub of camshaft.



416/013

Remove fastening screws (6) and intermediate ring.



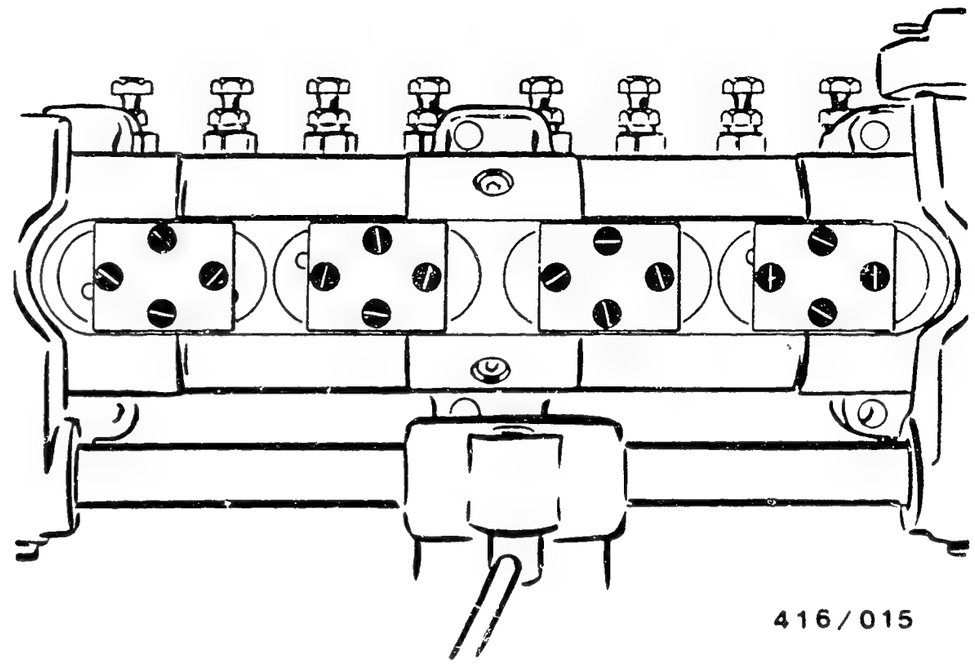
416/014

Series up to S 2999

Remove driving coupling and Woodruff key.

Tilt fuel-injection pump.

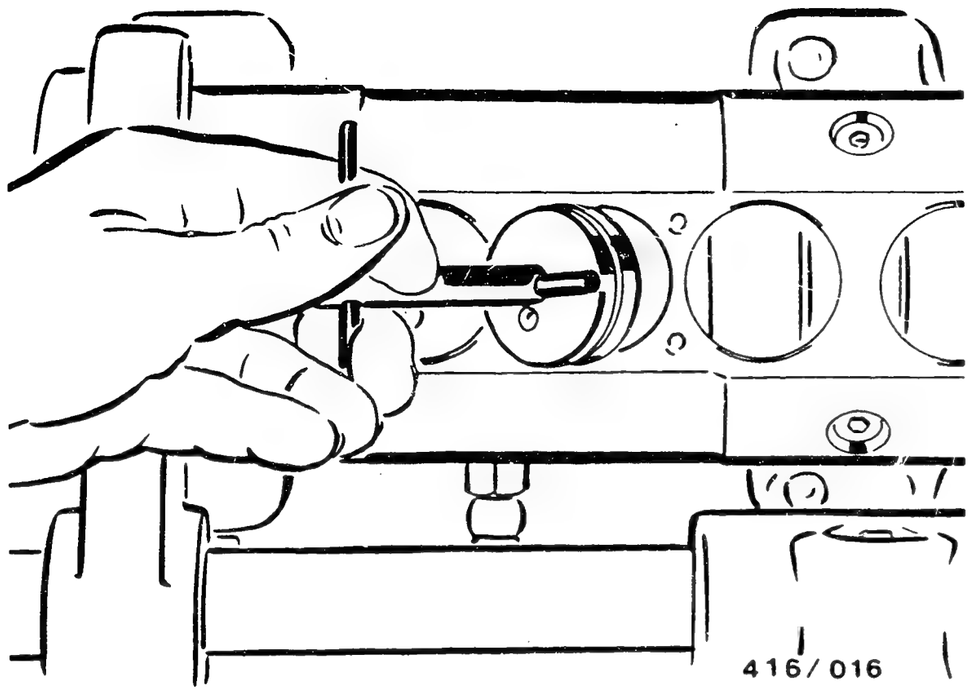
Remove base-cover screws using screwing tool KDEP 1072.



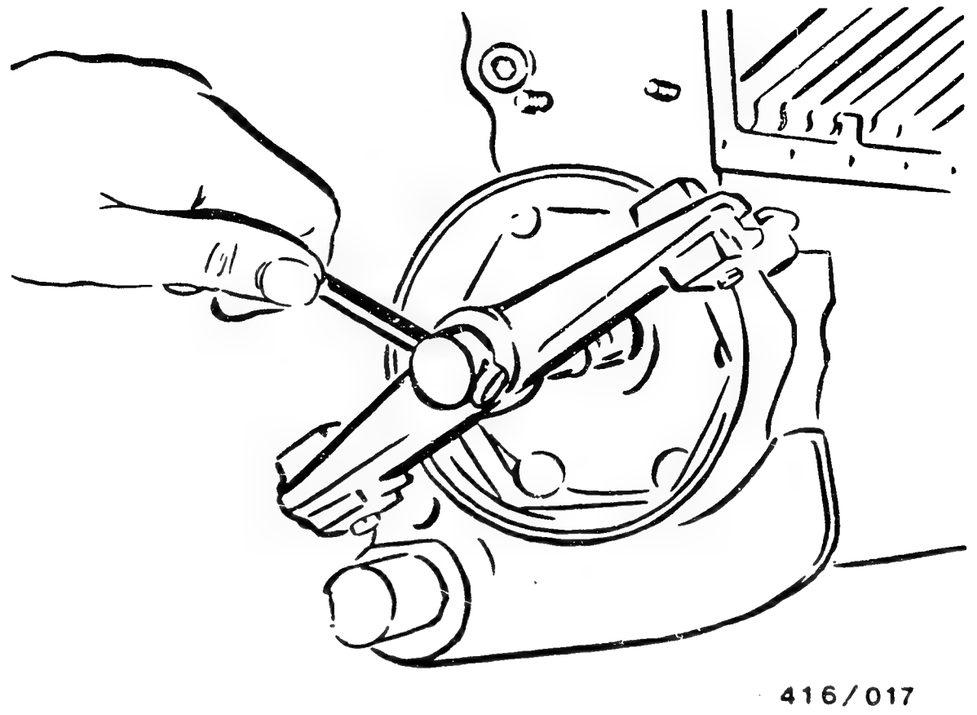
416/015

Series as of S 3000

Remove flat-head screws. Take off tab washers.

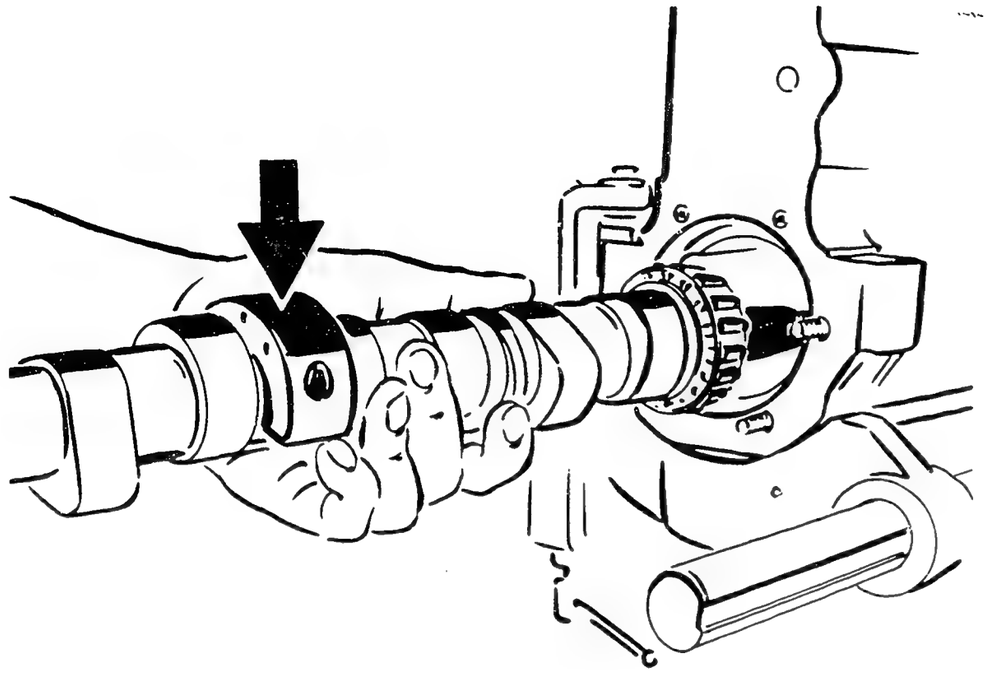


Pull out buse cover with mounting tool KDEP 1651.



Loosen bearing-end-plate fastening screws (6).
Pull off bearing end plate using commercially available extractor (e.g. Hahn & Kolb, 55030 020).

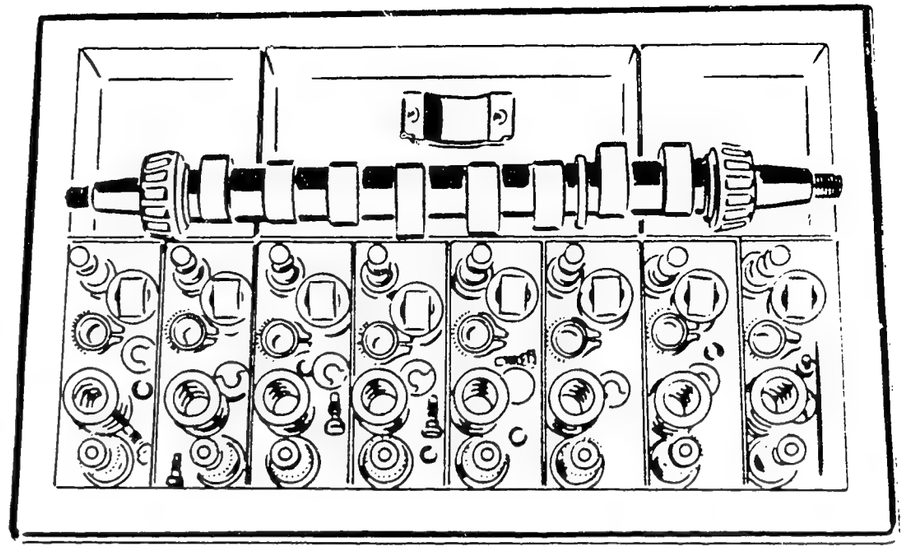
Note:
Do not twist bearing end plate when pulling it off.



416/018

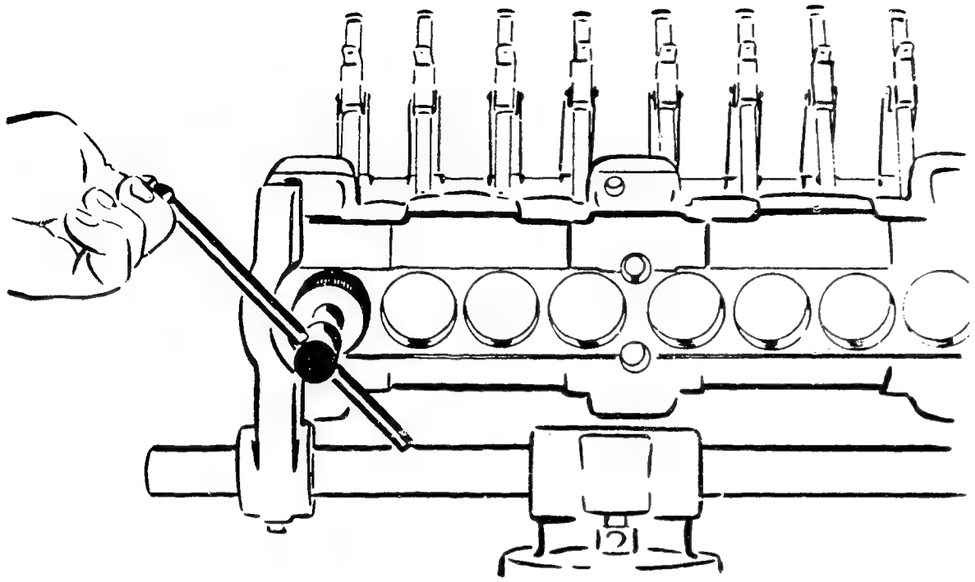
Remove screws at intermediate bearing (screws are provided with O-rings).

Pull camshaft with intermediate bearing (picture, arrow) out of camshaft chamber.



416/019

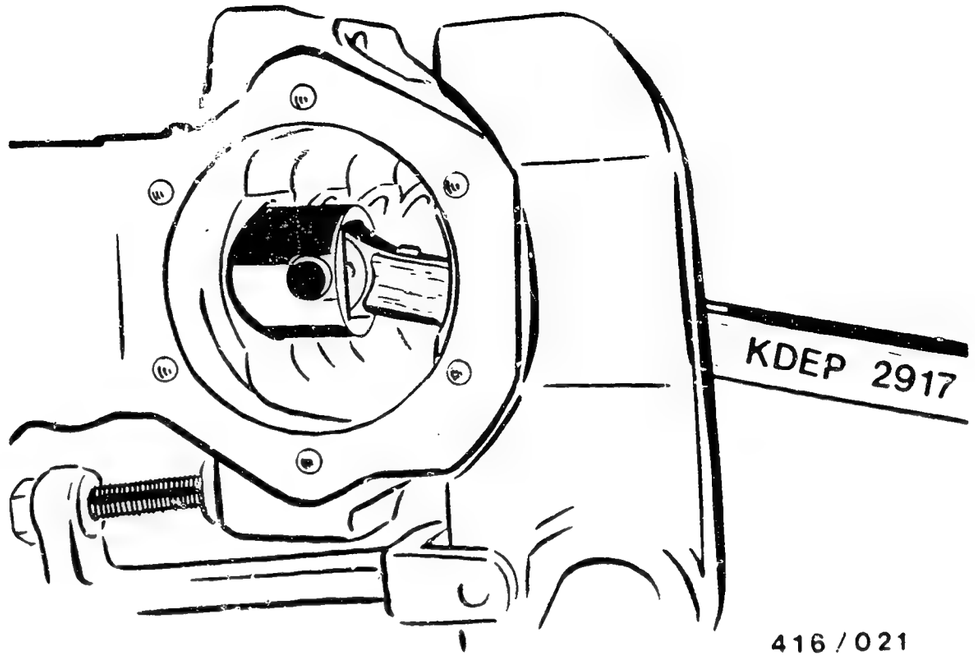
When performing subsequent work, all components of one barrel assembly are to be deposited in a clean, sub-divided box (e.g. picture).



416/020

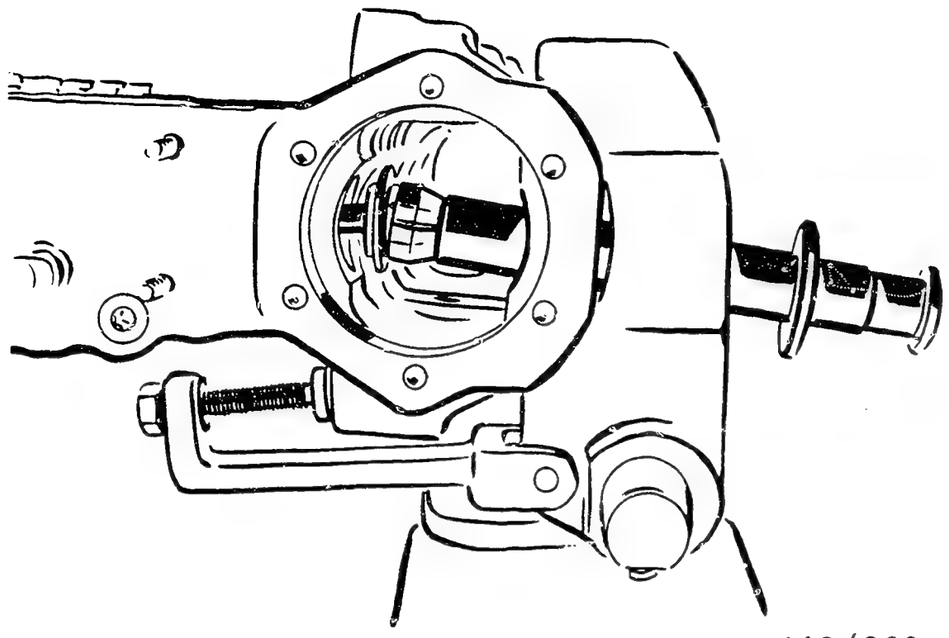
Series up to S 2999

Press up roller tappet with clamping fixture KDEP 1536 and remove tappet holder.



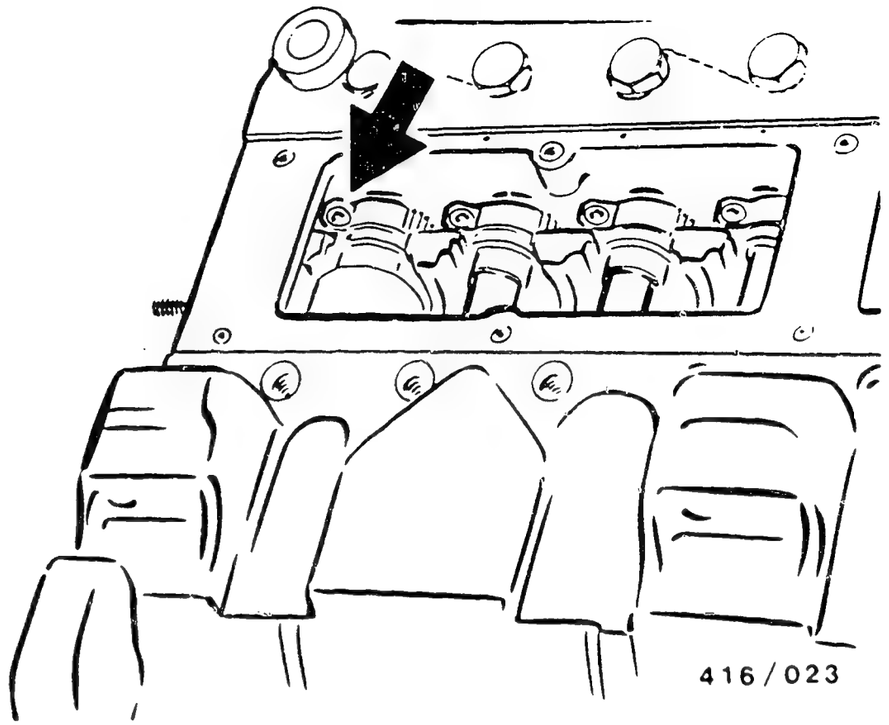
416/021

Release clamping fixture and remove roller tappet through hole in base with KDEP 2917.

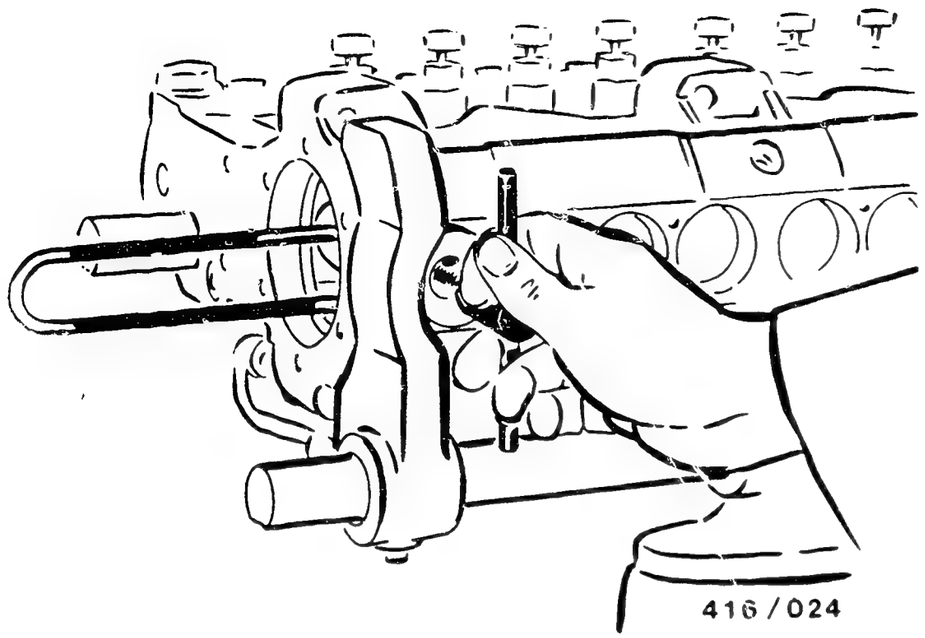


Using plunger grippers KDEP 1623 carefully pull out pump plunger with lower spring seat through opening in base.

Then remove plunger return spring.



Loosen clamping screw of gear segment (picture, arrow).
Using mounting tool KDEP 1652, pull control sleeve out of gear segment and remove it through hole in base.
Remove gear segment.

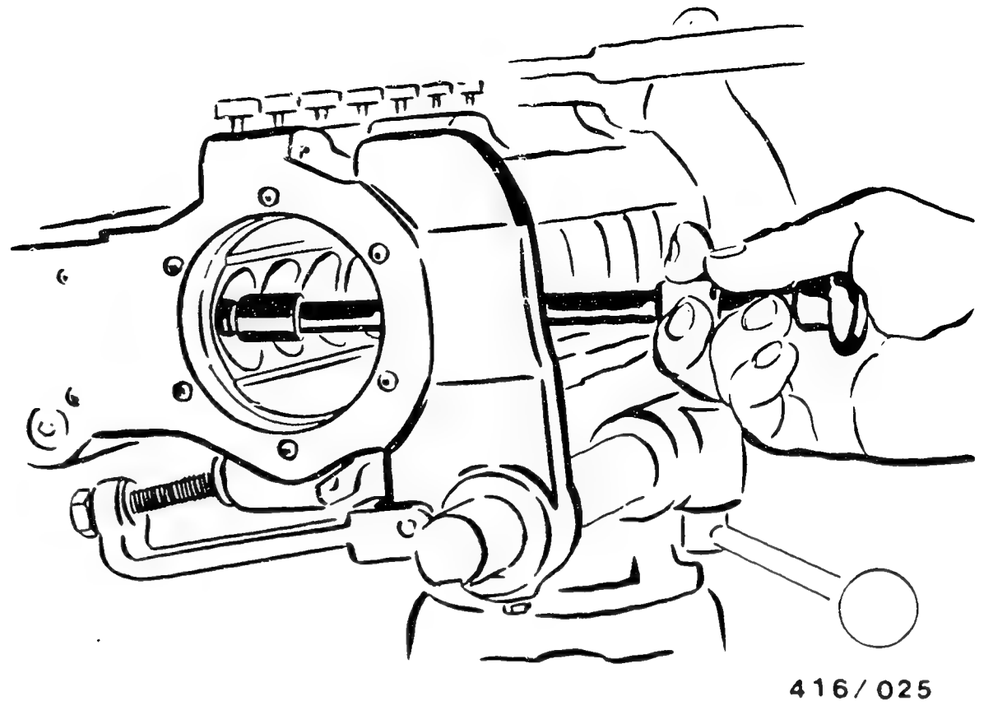


Series rs of S 3000

Press up roller tappet with clamping fixture KDEP 1535 and remove tappet holder.

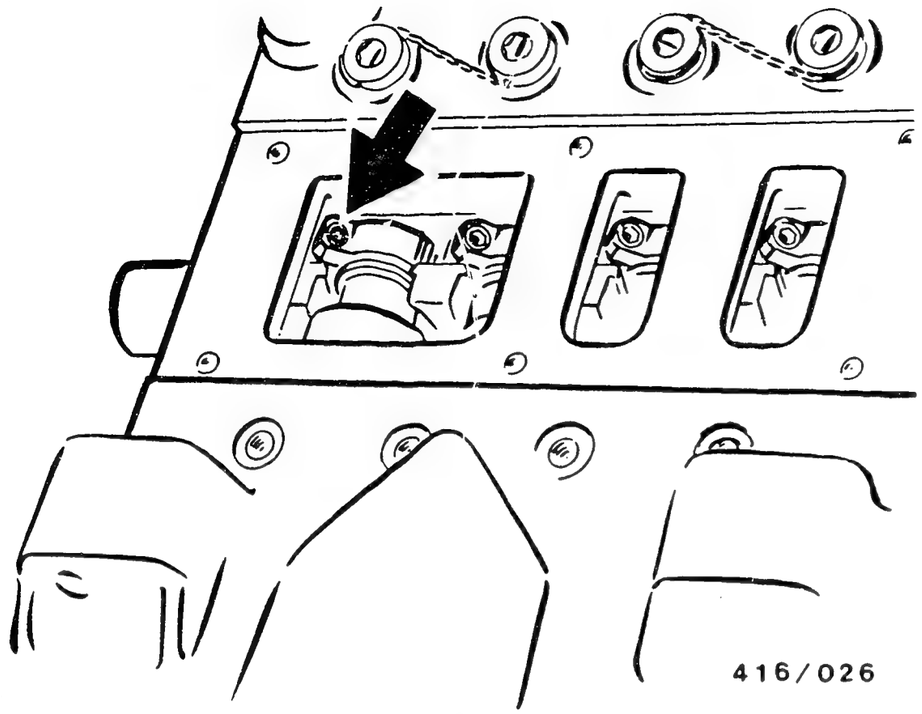
Loosen lock nut of tappet holder. Turn hex. drive against direction of arrow until drive moves freely. Remove tappet holder.

Release clamping fixture and remove roller tappet through hole in base using KDEP 2917 (with spring set KDEP 2917/0/3, special accessory).



Using plunger grippers KDEP 2942, carefully pull out pump plunger with lower spring seat through opening in base.

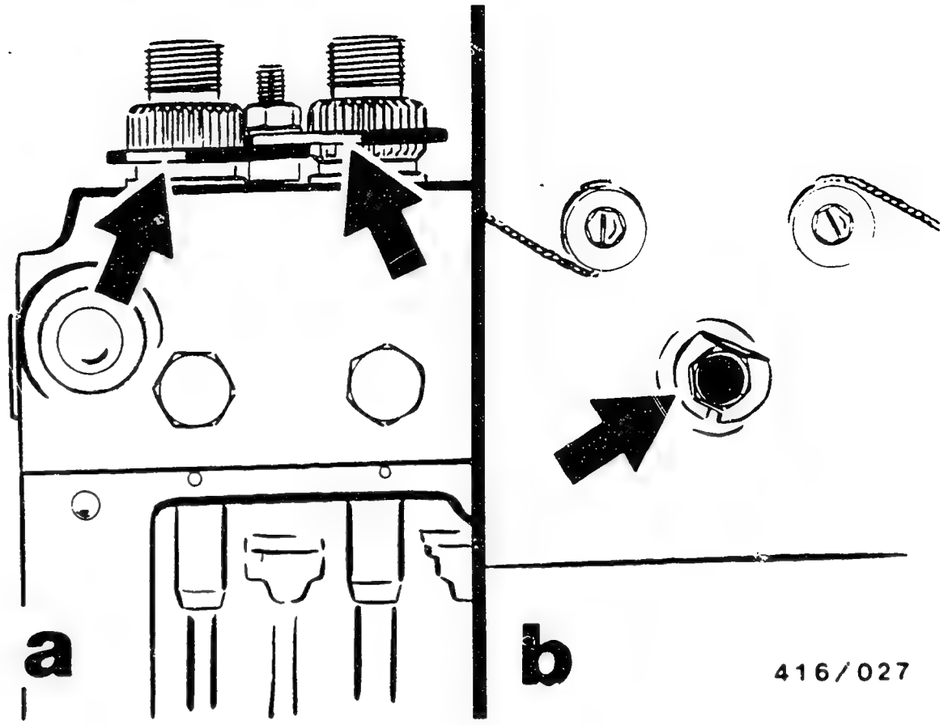
Then remove plunger return spring.



Loosen clamping screw of gear segment (picture, arrow).

Pull control sleeve out of gear segment using mounting tool KDEP 1652 and remove it through opening in base.

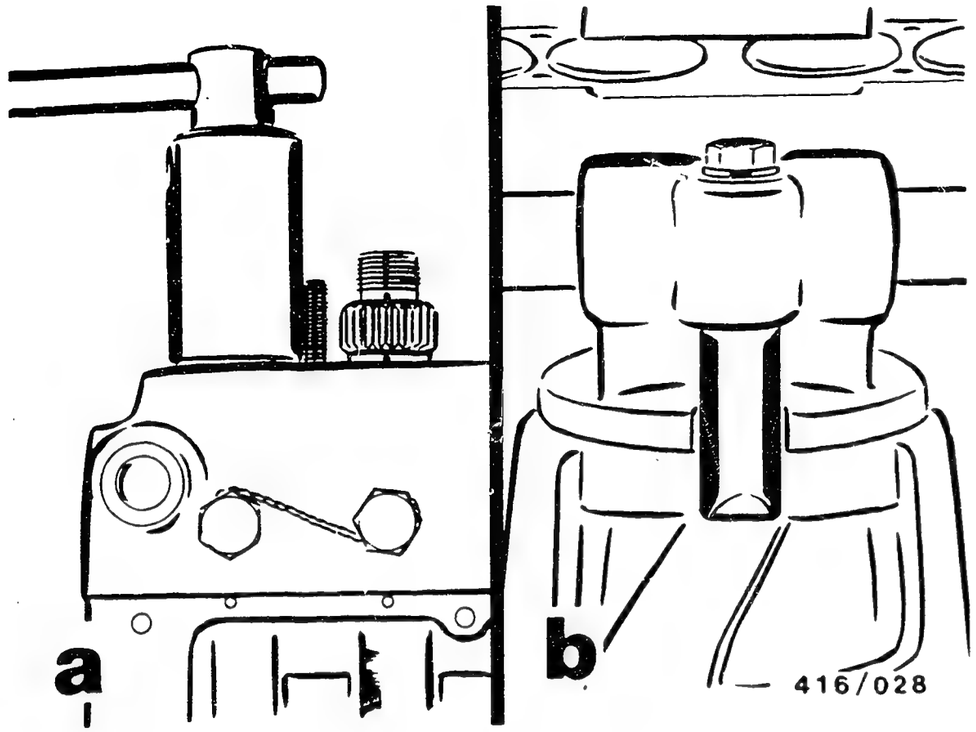
Remove gear segment.



Remove straps at delivery-valve holders (picture a, arrows).

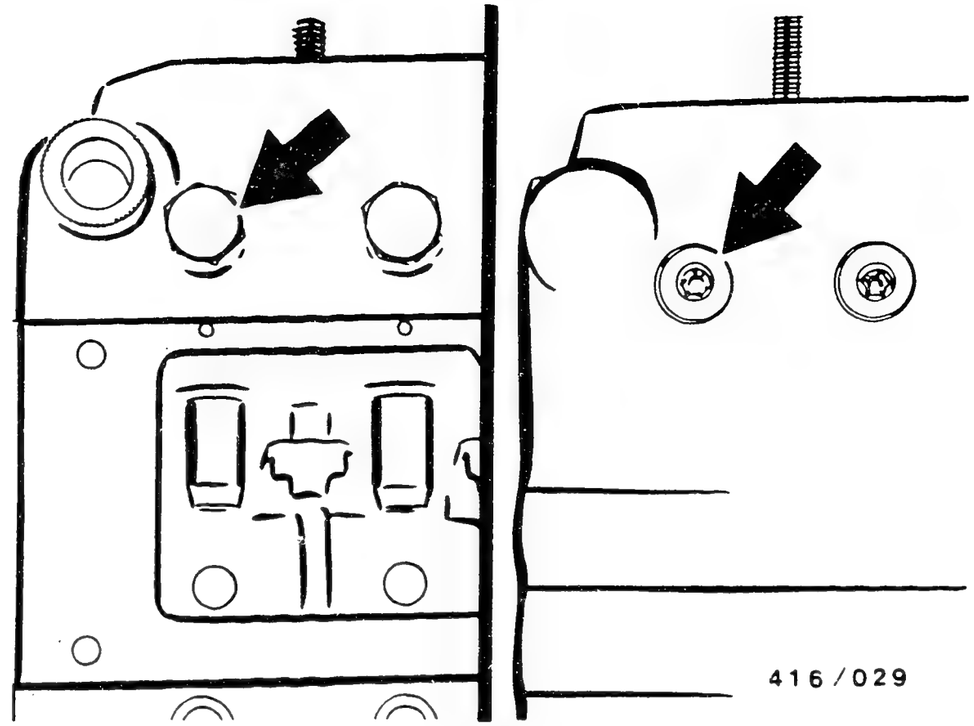
Remove control-rod positioning screw (picture b, arrow).

Pull control rod out of pump housing.



Unscrew delivery-valve holder with serrated wrench KDEP 2920 (picture a).

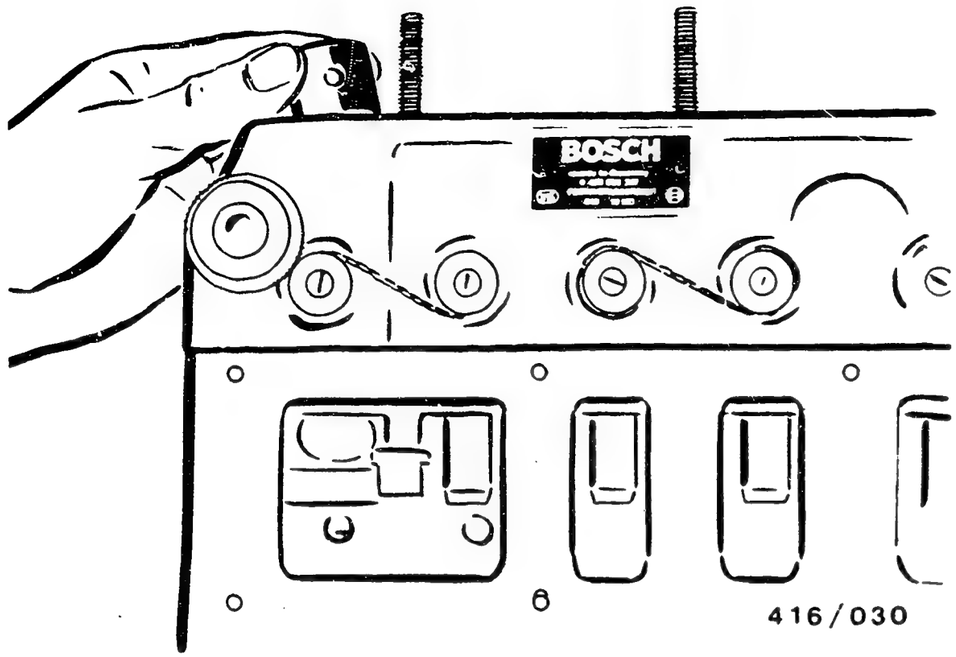
If delivery-valve holders are extremely tight, the top part of the clamping support is to be additionally secured against turning (picture b) with the aid of the long bushing KDEP 2919/1/14 (special accessory).



Series up to S 2999

Remove baffle screws on either side (picture, arrows). Press pump barrel upwards out of pump housing (pay attention to O-ring) and place it in respective compartment in box.

Note:
Pump barrel and pump plunger must n o t b e m i x e d u p on account of their accuracy of fit (ground as a pair).

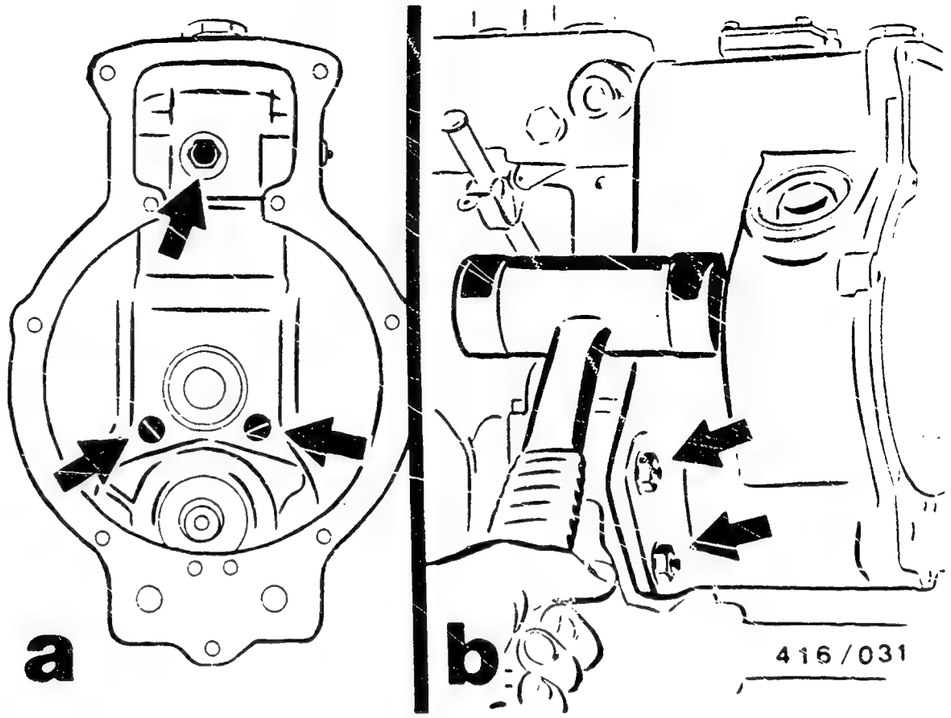


416/030

Series cs of S 3000

Press pump barrel upwards out of pump housing (paying attention to O-ring) and place it in respective compartment in box.

Note:
Pump barrel and pump plunger must n o t b e m i x e d u p on account of their accuracy of fit (ground as a pair).

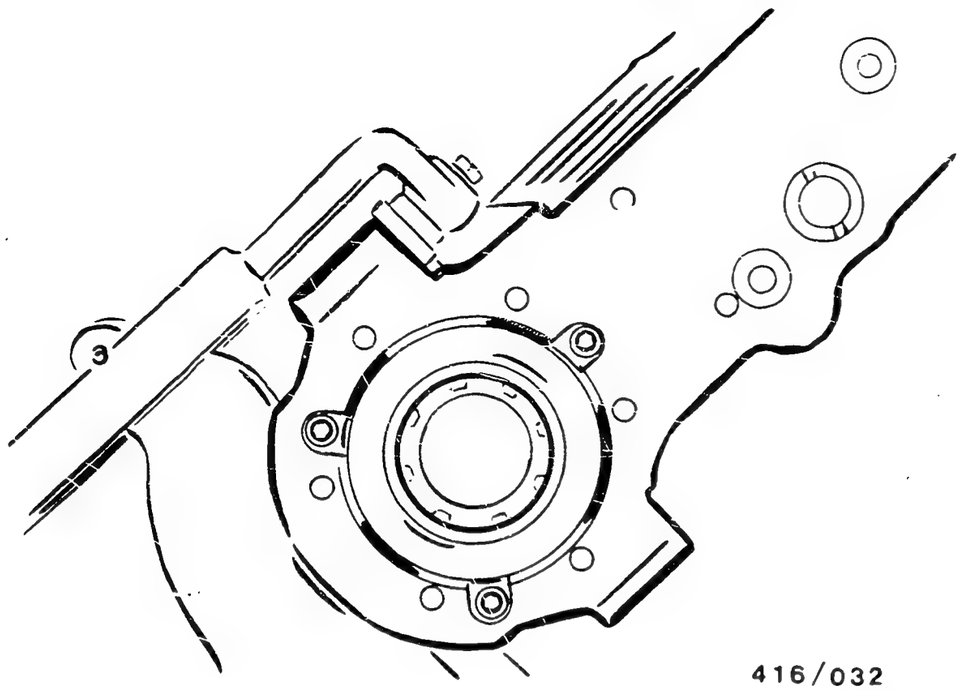


416/031

Series up to S 2999 and S 3000

Unscrew fastening screws of governor housing (picture a, arrows).
Remove fastening screws (4) on side (picture b, arrows).

Detach governor housing from pump housing (picture b) by tapping carefully on either side (with plastic hammer).
Do not twist pump housing.



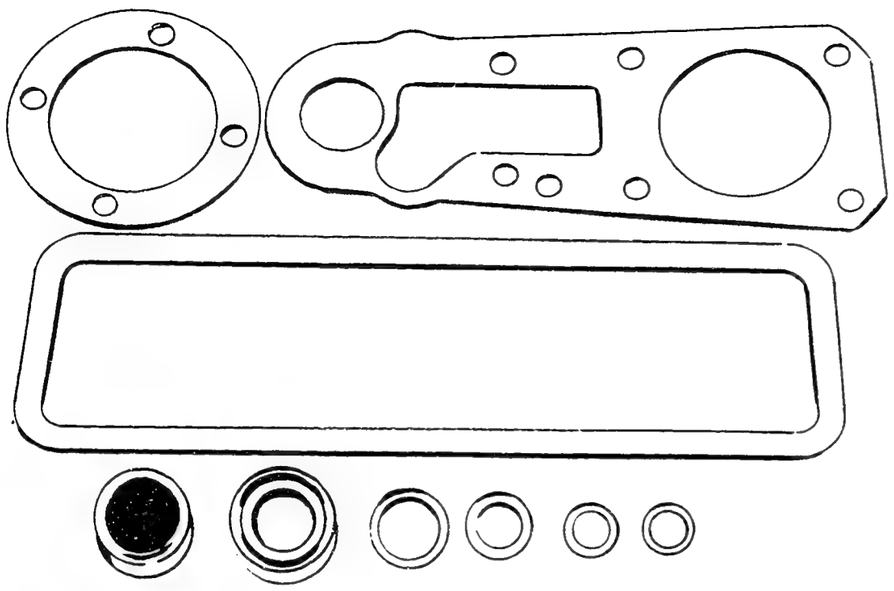
416/032

Loosen bearing fastening screws (3).
Press bearing end plate out of pump housing with suitable mandrel.

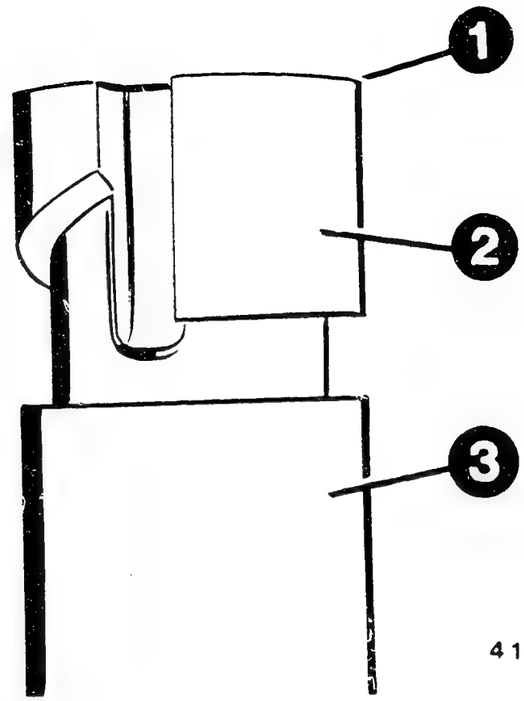
CLEANING PARTS

Wash out parts in a commercially available cleaning agent, e.g. chlorothene NU, which is not readily flammable and then blow out with compressed air.

Pay attention to the following safety precautions!
Order Governing Work Involving Combustible Liquids (Vbf) as issued by the Federal Labor Ministry (BmA).
Safety regulations for the handling of chlorinated hydrocarbons
for companies ZH 1/222
for employees ZH 1/129
as issued by the Hauptverband für Gewerbliche Berufsgenossenschaften (Zentralverband für Unfallschutz und Arbeitsmedizin) Langwartweg 103, 5300 Bonn 5, West Germany.
Outside West Germany, attention is to be paid to the corresponding local regulations.



410/105



410/106

1 = Helix
2 = Head area
3 = Bearing surface

COMPONENT TESTING

Renew worn or damaged parts.
A l w a y s renew flat seal rings, radial-lip-type oil seals, O-rings and copper seal rings.

Test plunger-and-barrel assemblies

Renew plunger-and-barrel assemblies if they reveal the features listed below:
- rounded helices
- matt areas in head area
- running marks at bearing surfaces
- sticking plunger-and-barrel assemblies (can be established by way of slide test).

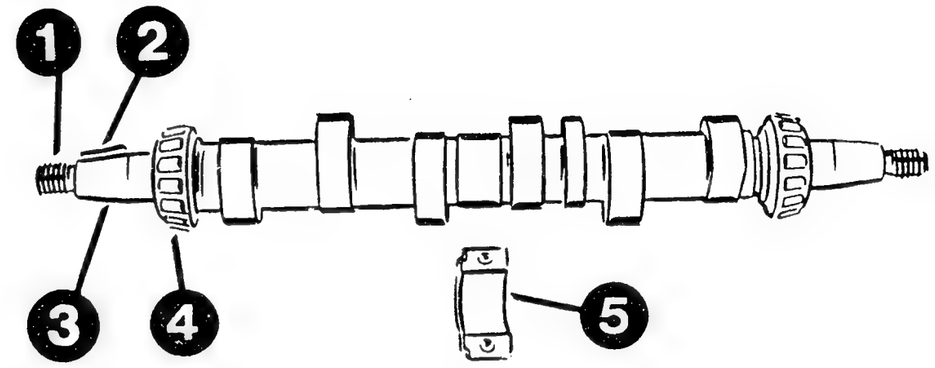
Note:
Wash out plunger and barrel in calibrating oil before performing slide test on plunger-and-barrel assembly. Hold pump plunger and pump barrel more or less vertical. The pump plunger must slide down on account of its own weight.

Series up to S 2999

When renewing plunger-and-barrel assemblies, the spring seat (also used for LPC adjustment) is likewise to be replaced.

Series as of S 3000

The pressure plate is likewise to be renewed when replacing plunger-and-barrel assemblies.



410 / 108

1 = Thread
2 = Keyway
3 = Cone
4 = Camshaft bearing
5 = Intermediate bearing

Test camshaft

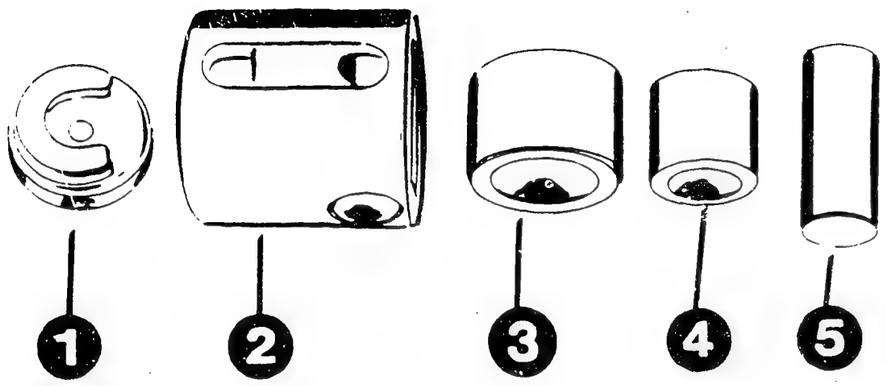
Visual inspection for:

- pronounced running marks on cams
- worn, damaged keyway
- damage to thread or cone

Renew camshaft if complaint is justified.

Note:

Renew camshaft bearing and intermediate bearing as a general rule when carrying out repairs.



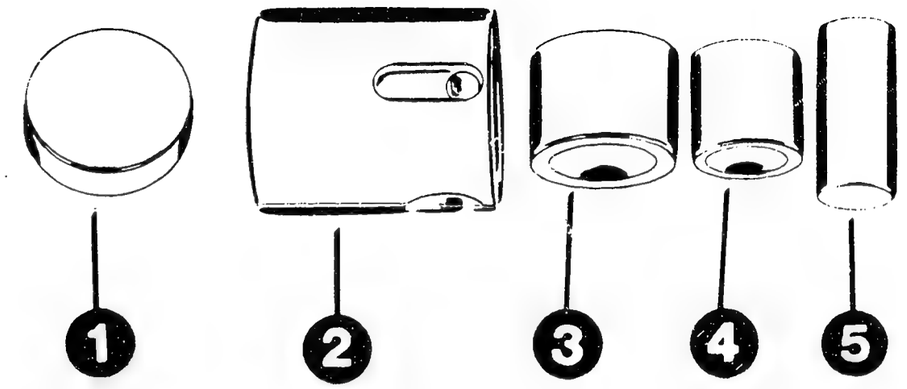
416/033

1 = Spring seat (likewise envisaged for LPC adjustment)
2 = Roller-tappet shell
3 = Roller
4 = Bushing
5 = Bearing pin

Series up to S 2999

Renew roller tappet/individual components in the event of the following damage:
- dented spring seats
- pronounced running marks at roller-tappet shell
- pronounced running marks and/or discoloration at roller, bearing pin and bushing.

Note:
When replacing plunger-and-barrel assemblies, the spring seat is likewise to be replaced as a general rule.



416 034

1 = Pressure plate
2 = Roller-tappet shell
3 = Roller
4 = Bushing
5 = Bearing pin

Series as of S 3000

Renew roller tappet/individual components in the event of the following damage:
- dented shim
- pronounced running marks at roller-tappet shell
- pronounced running marks and/or discoloration at roller, bearing pin and bushing.

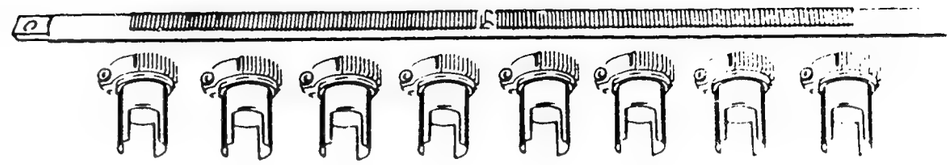
Note:
When replacing plunger-and-barrel assemblies, the pressure plate is also to be renewed as a general rule.

Note:
Check roller-tappet guide in pump housing for scoring in the event of severe running marks at roller-tappet shell.

Series up to S 2999
If a new roller tappet or a new spring seat is installed, fit spring seat of same thickness.

Series as of S 3000
If a new roller tappet or a new pressure plate is installed, fit pressure plate of same thickness.

Final adjustment is performed on a test bench.



416/035

1 = Control rod
2 = Gear segment
3 = Control sleeve

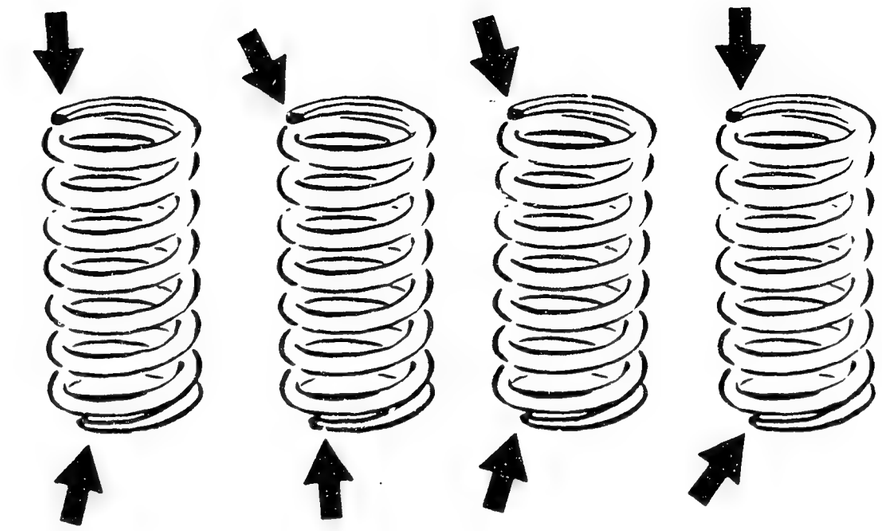
Test control rod and control sleeves

Series up to S 2999 and as of S 3000

Renew parts if gear segments/control rod in gear teeth or control sleeves in slot for plunger control arm are worn/damaged.

416/036

Additionally test split control rod (see picture) for ease of movement.

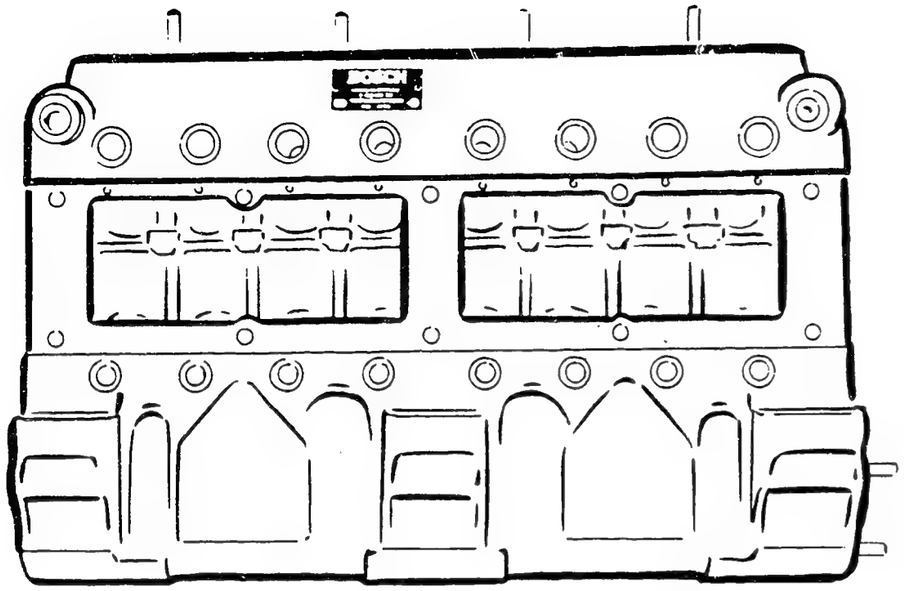


410/44

Test plunger return springs

Plunger return springs, which are corroded or whose surface is damaged, must be replaced on account of the danger of fracture.

The area of the 1st turn seating surface is to be subjected to particular testing (picture, arrows).



416/037

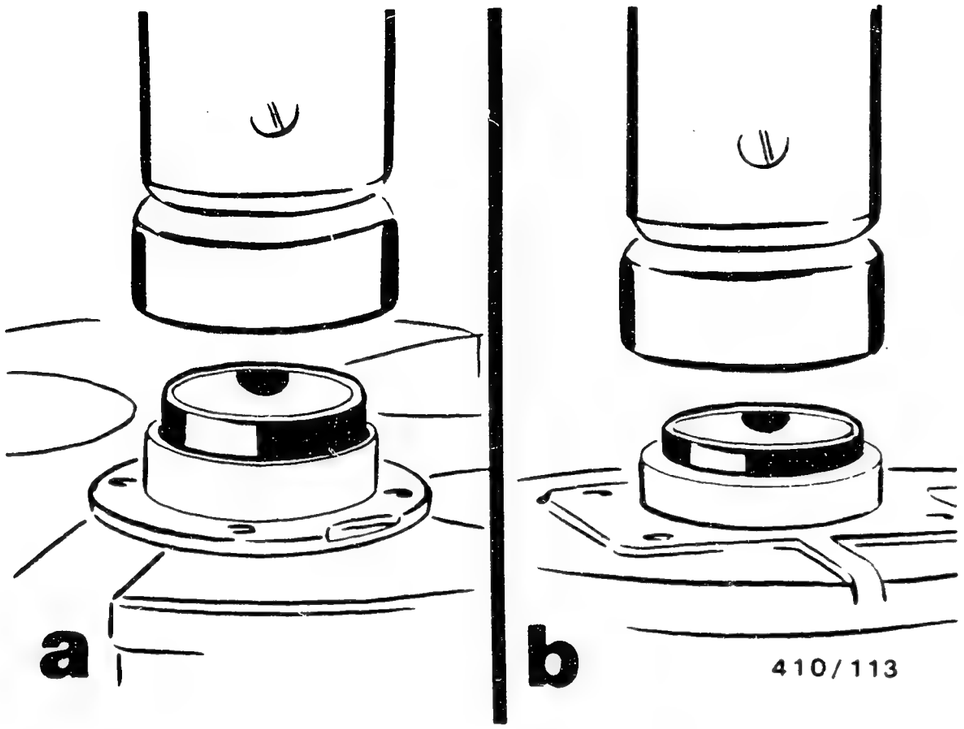
Test pump housing

Check housing for cracks and other external damage.

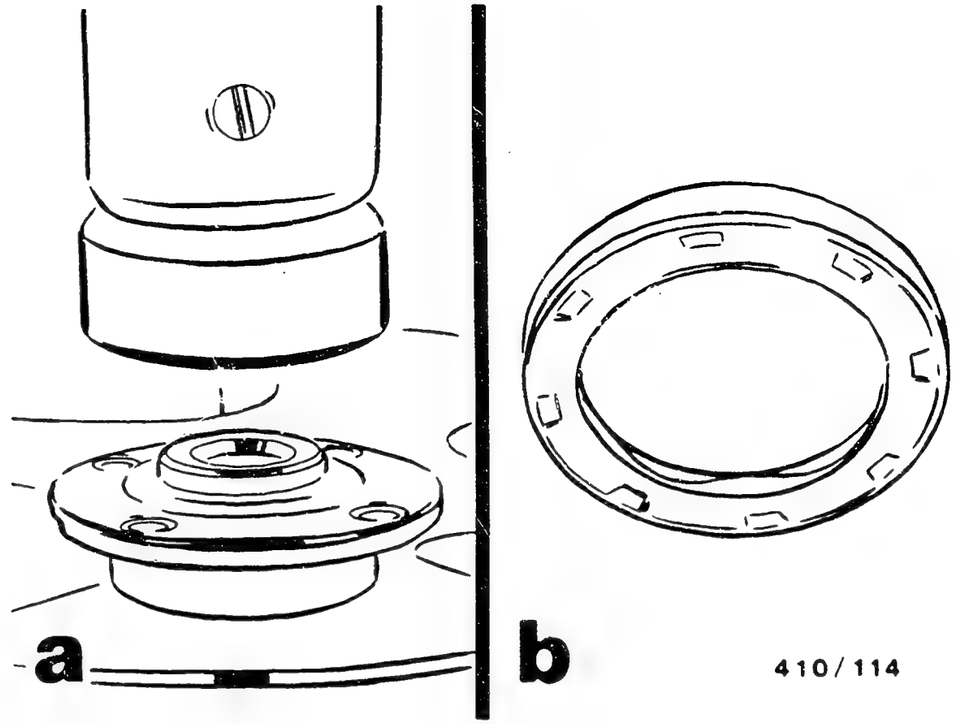
Pay particular attention to the following:
- thread at stay bolt and inserts
- scoring on roller-tappet guides
- freedom of movement of control rod in its guide
- cavitation in suction gallery
- unevenness/fuel deposits at seats for plunger-and-barrel assemblies.

Bearing outer race renewal

Remove bearing outer races from bearing end plate with commercially available extractor (e.g. Hahn & Kolb, ball-bearing internal extractor 55 105, counter-support 55 106)



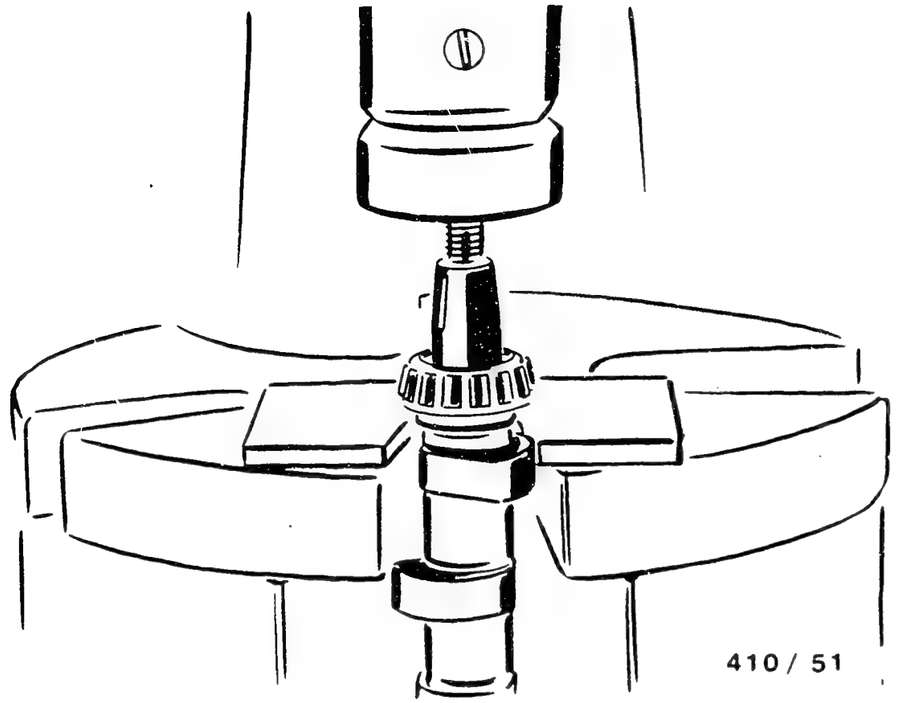
Press new bearing outer races under mandrel press into bearing end plate as far as bearing seat (pictures a,b).



Replacement of radial seals

Apply small quantity of lubricant to outside of new radial-lip-type oil seal and press it flush into bearing end plate (picture a).

Note:
Cone and sealing surface must be grease-free when installing camshaft in the case of fuel-injection-pump versions with seal ring of the type illustrated in picture b.
Fill double-lip seal ring with high-temperature grease between sealing lips.

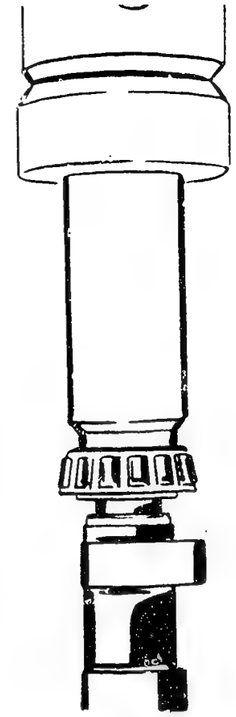


410/51

Camshaft-bearing renewal

Press off camshaft bearing under mandrel press using release plate KDEP 1580.

Note:
The release plate is suitable for all camshaft diameters.
The camshaft is therefore to be pushed into the recess until the bearing collar makes contact on either side.

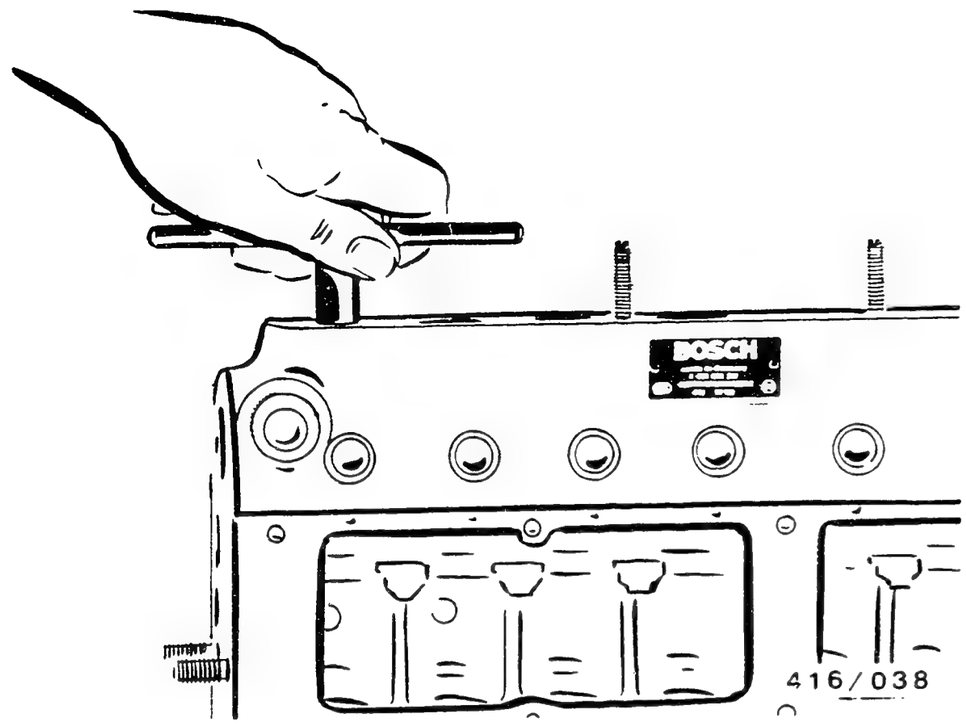


410/52

Press on new camshaft bearings under mandrel press with pressing-on sleeve. Re-use existing shims for axial-clearance adjustment on same side.

Fit shims such that thick ring with lug faces in direction of cam.

Note:
Pressing-on sleeve KDEP 1583 can be used for 30 mm cone
Pressing-on sleeve KDEP 1559 can be used for 35 mm cone.



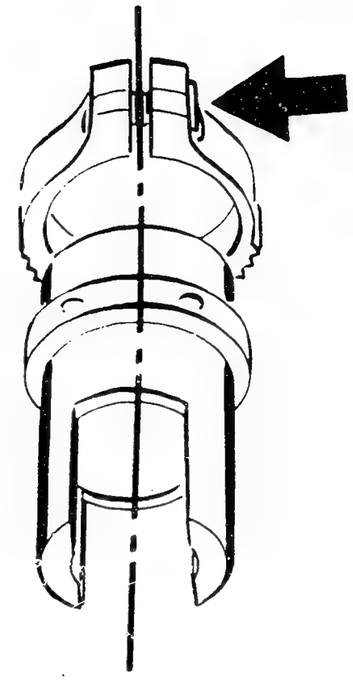
Reworkirg seats for plunger-and-barrel assemblies

Re-cut (smooth) seats for plunger-and-barrel assemblies carefully and without exerting much pressure by means of hand cutter, so as to eliminate any unevenness and/or fuel deposits.

Series up to S 2999
Use hand cutter KDEP 2958.

Series as of S 3000
Use hand cutter KDEP 1653.

Note:
After performing the work, wash out pump housing in cleaning agent.



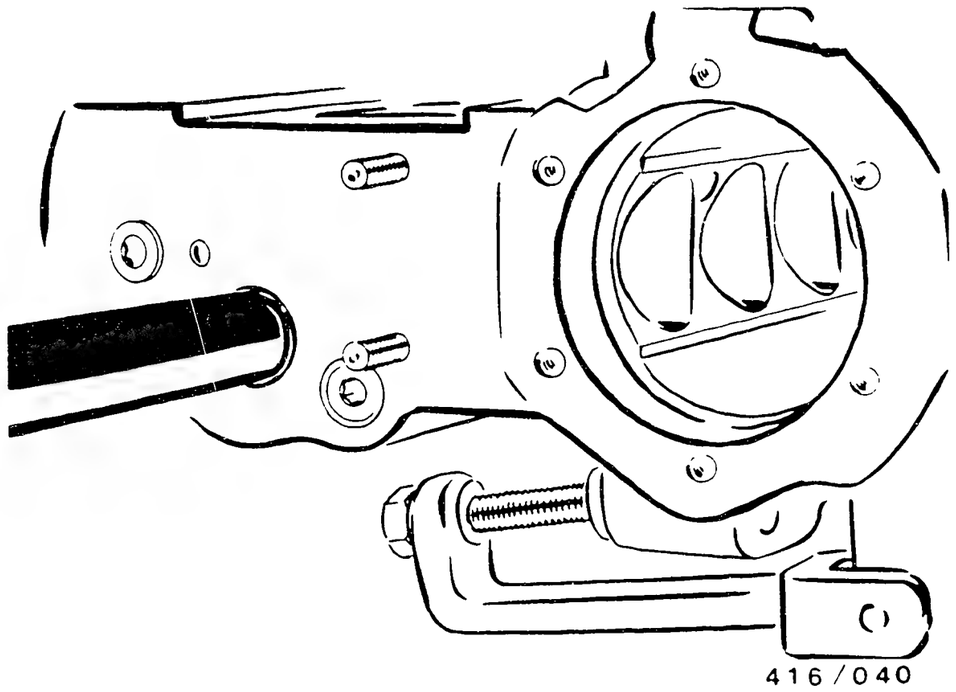
Renewal of gear segments at control sleeve

Renew worn gear segments by loosening clamping screw (picture, arrow).

Fit new gear segment centrally on control sleeve (picture).

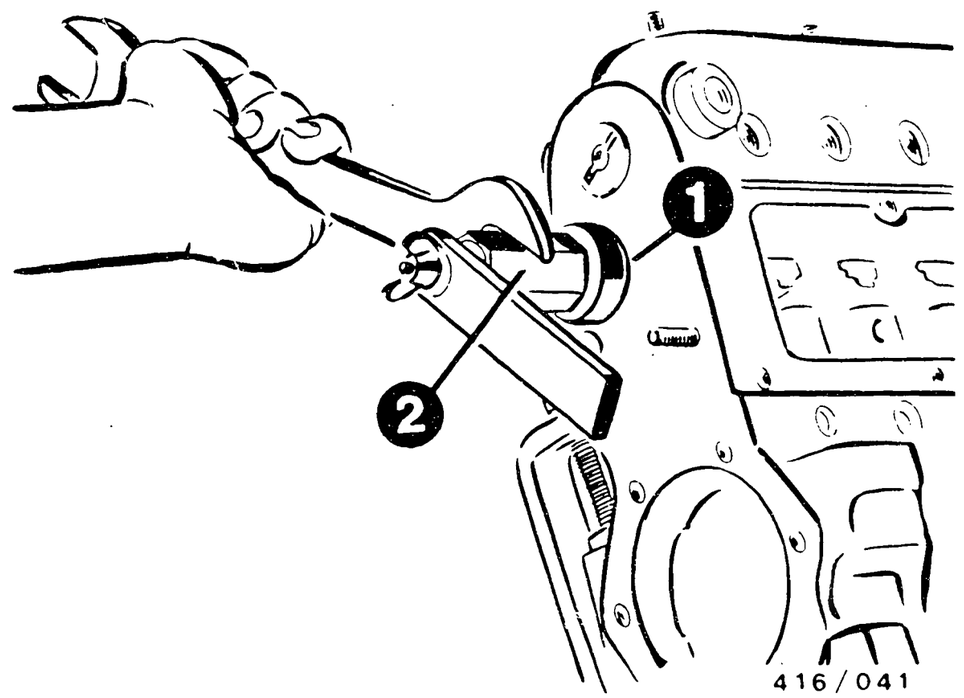
Holes for turning control sleeve must face forwards.

Note:
After tightening the clamping screw, the cheeks of the gear segment must n o t make contact with one another.



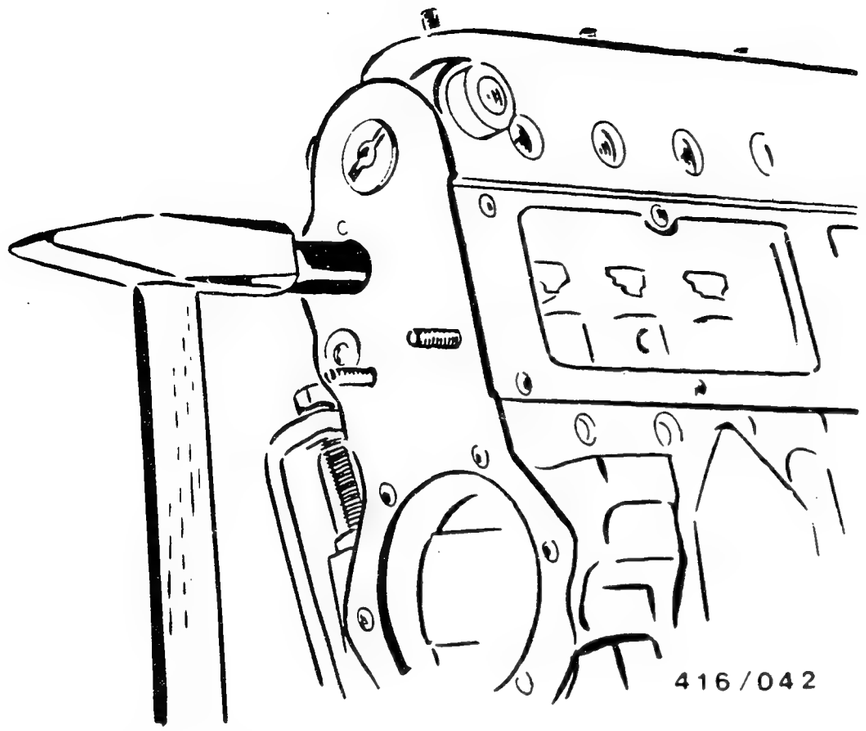
Renewal of worn control-rod guide bushings

Use KDEP 2970 to remove threaded bushing.



1 = Base support KDEP 1654
2 = Puller KDEP 1056

Use puller KDEP 1056 to remove the two control-rod guide bushings.



Knock new guide bushings into pump housing with press-in mandrel KDEP 1655.

Clamp on pump housing.

Use reamer KDEP 1622 and guide sleeve to ream control-rod guide bushing to control-rod diameter.

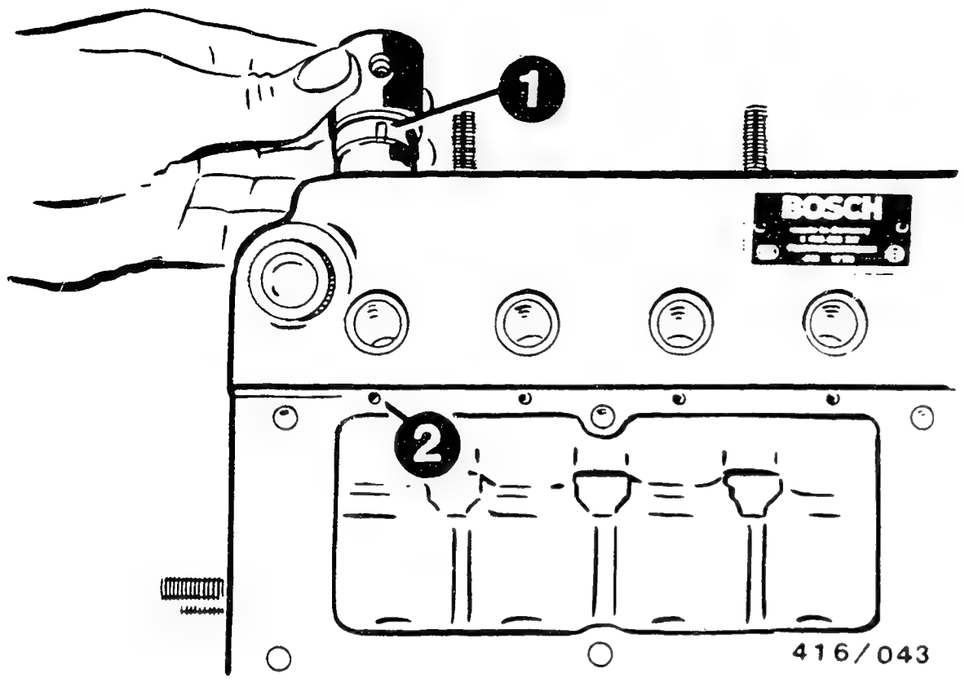
Note:

After reaming the guide bushings, insert the control rod without twisting it, turn it to 360° and slide it in.

It must be possible to move the control rod freely without it jamming.

The guide bushings are to be re-reamed if necessary.

Thoroughly wash out pump housing.



1 = Guide groove
2 = Positioning pin

FUEL-INJECTION PUMP ASSEMBLY

Clamp on injection-pump housing.

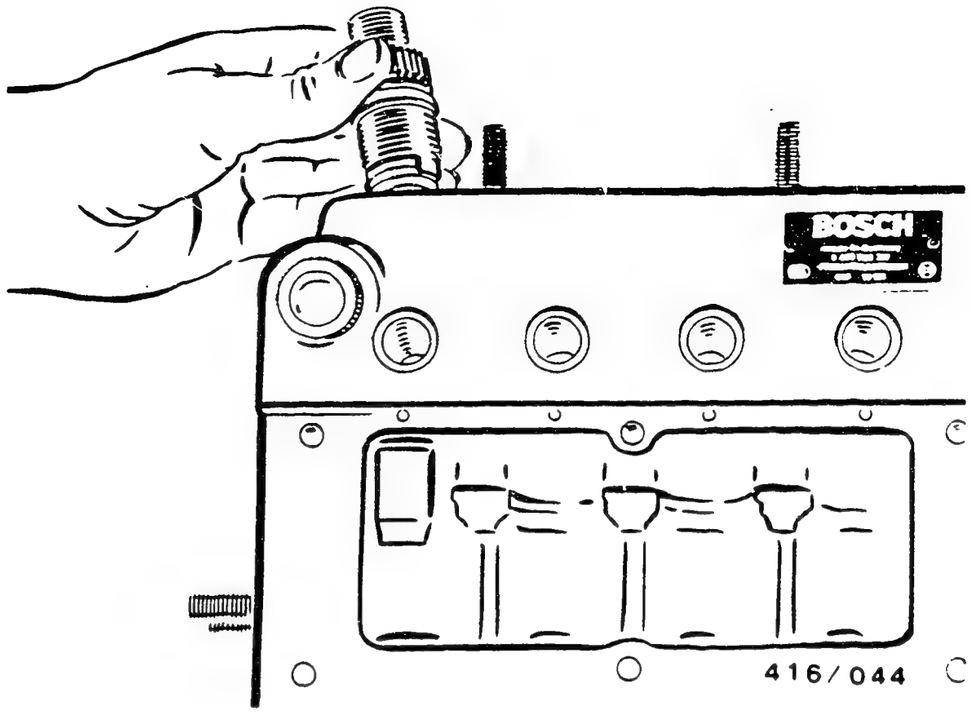
When performing subsequent operations, exclusive use is to be made of cleaned, non-worn and non-damaged components.

Pump-barrel installation

Insert O-ring into pump housing beneath guide pin.

Apply small quantity of grease to bevel of pump barrel.

Insert pump barrel in housing such that positioning pin engages in guide groove. This ensures that the barrel cannot turn.



Installation of delivery-valve assemblies

Examine delivery-valve assemblies at surface forming seal with plunger-and-barrel assembly to see whether there is any gum formation.

Re-lap gummed sealing surface.
Fit delivery-valve assemblies without applying any grease.

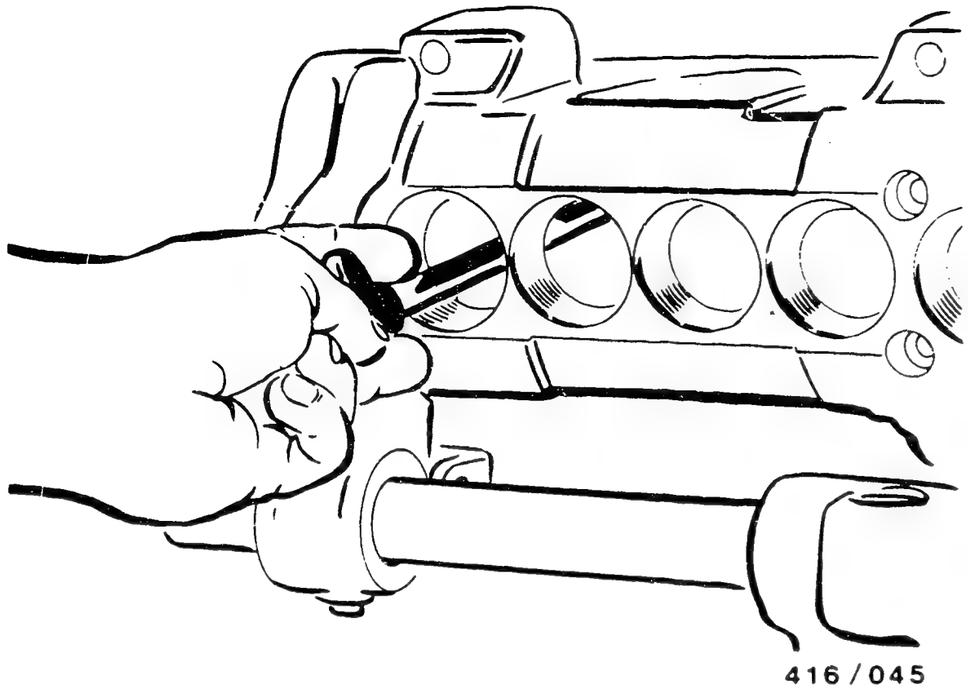
The seal ring is to be renewed in the case of constant-volume valves.

Screw in delivery-valve assemblies.
Tighten delivery-valve assemblies using serrated wrench KDEP 2920 and applying prescribed tightening torque.
Pay attention to t i g h t e n i n g s e q u e n c e .

Tightening torques:

Series up to S 2999
100-0-90...95 Nm

Series as of S 3000
200-0-190...200 Nm



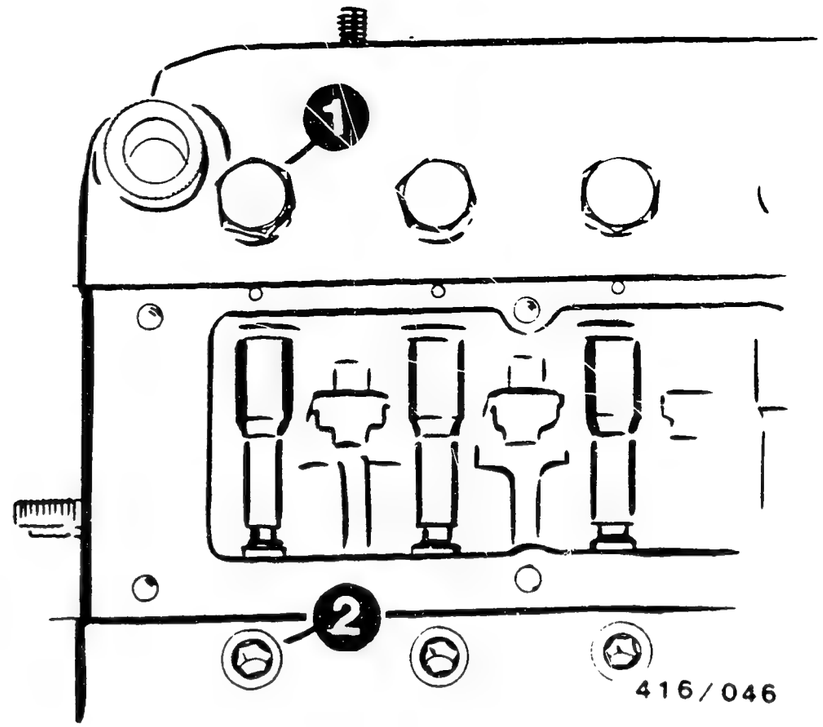
416/045

Suction-gallery leak test

Preparation:
Tilt housing (approx. 90°)

Moisten pump plunger with calibrating oil and insert it in pump barrel using plunger grippers KDEP 2942. Check to see that pump plunger moves freely.

Note:
If it does not move freely, remove plunger-and-barrel assembly and re-cut (smooth) seat for plunger-and-barrel assembly.



416/046

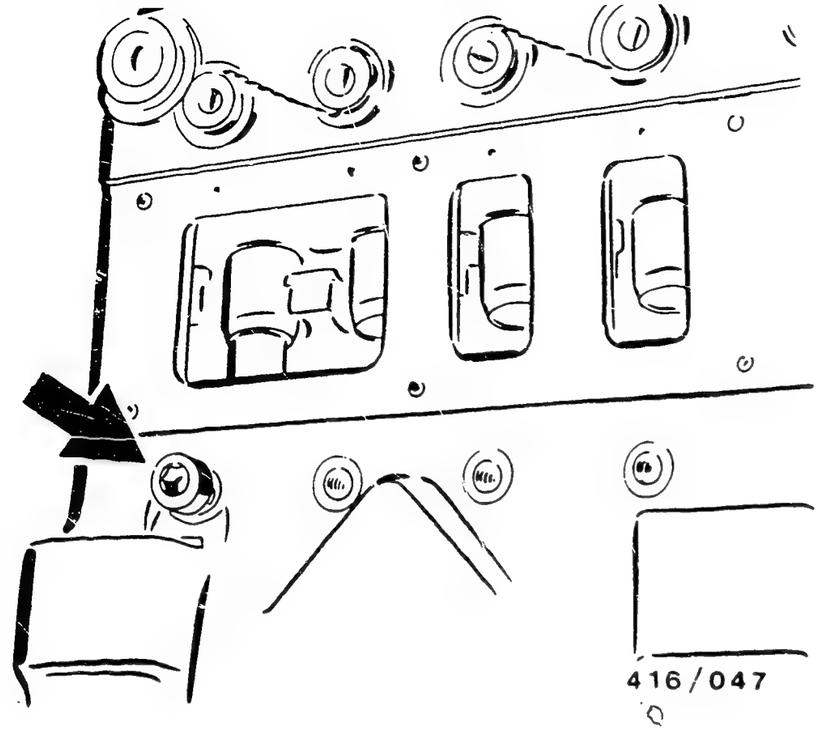
Series up to S 2999

1 = Baffle screw
2 = Screw (M 10 x 45)

Screw in baffle screws on either side and tighten to prescribed tightening torque.

Hexagon bolt	M 10	25...30 Nm
	M 14	40...45 Nm
Hexagon-socket-head cap screw		40...50 Nm

Screw in screws (M10 x 45, cut thread) to restrict lift of pump plunger.



Series ..s of S 3000

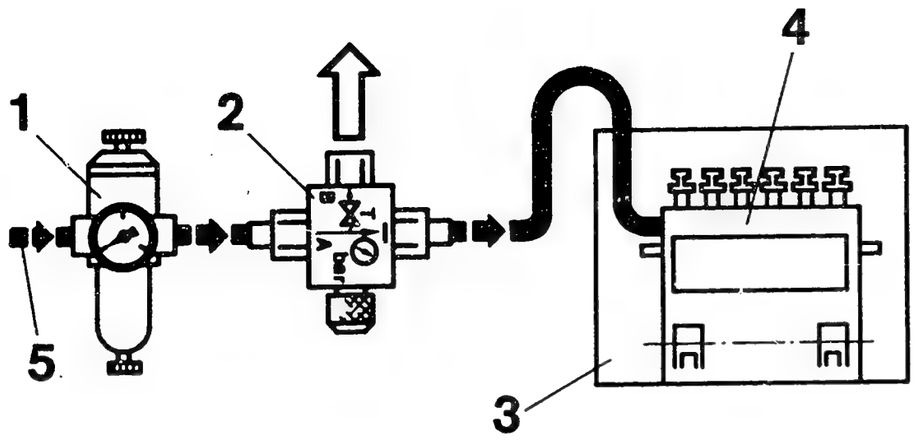
Screw in screws (M 10 x 45, cut thread) to restrict lift of pump plunger (picture, arrow).

Unscrew housing from clamping support.

Before immersing it in calibrating oil, connect pump housing via pressure regulator with water separator to compressed-air network.

To effect prescribed reduction in pressure during leak test, fit directional-control valve KDJE-P-100/1 of pressure measuring device KDJE-P 100 in compressed-air inlet.

Seal unused fuel inlet connections.



410/128

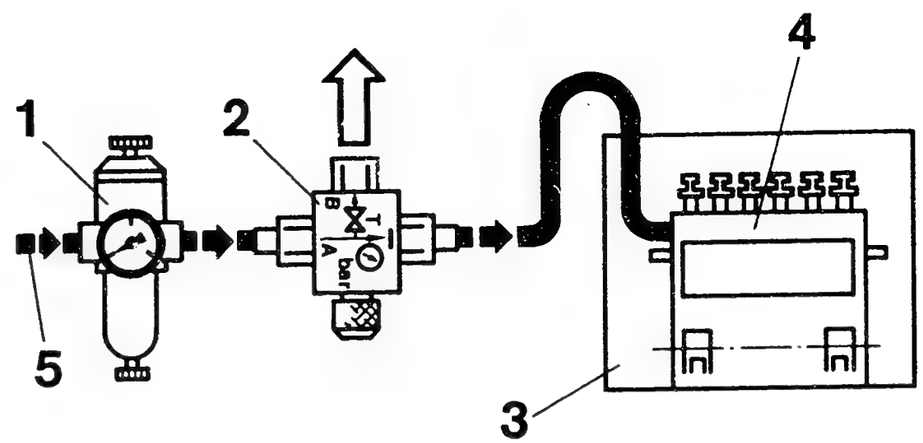
1 = Pressure regulator with pressure gauge 0...6 bar
and water separator
2 = Directional-control valve KDJE-P 100/1
3 = Immersion bath containing calibrating oil
4 = Fuel-injection pump
5 = Compressed air

Suction-gallery test

Immerse housing in test bath, spring chamber faces upwards.

Leaks in the area of the suction gallery are not permitted. Pay particular attention to leakproofness of O-ring seals.
Leaks between barrel and plunger are an exception.
Leaking constant-pressure valves are to be replaced.

D01



410/128

1 = Pressure regulator with pressure gauge 0...6 bar
and water separator
2 = Directional-control valve KDJE-P 100/1
3 = Immersion bath containing calibrating oil
4 = Fuel-injection pump
5 = Compressed air

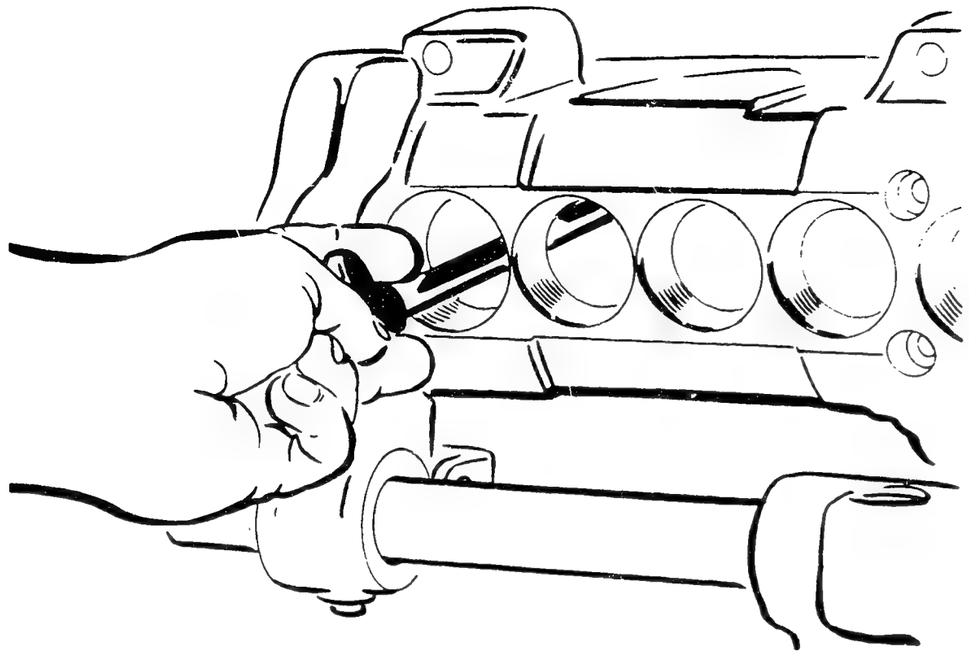
Test duration and test pressure:
at least 1 min. at 5 bar

If a plunger-and-barrel assembly seat leaks, unscrew delivery-valve holder, remove barrel and renew O-ring.

Repeat leak test.

Note:
In order to prevent skin irritation, apply handcream beforehand and wash hands in soap and water after completing test.

D02



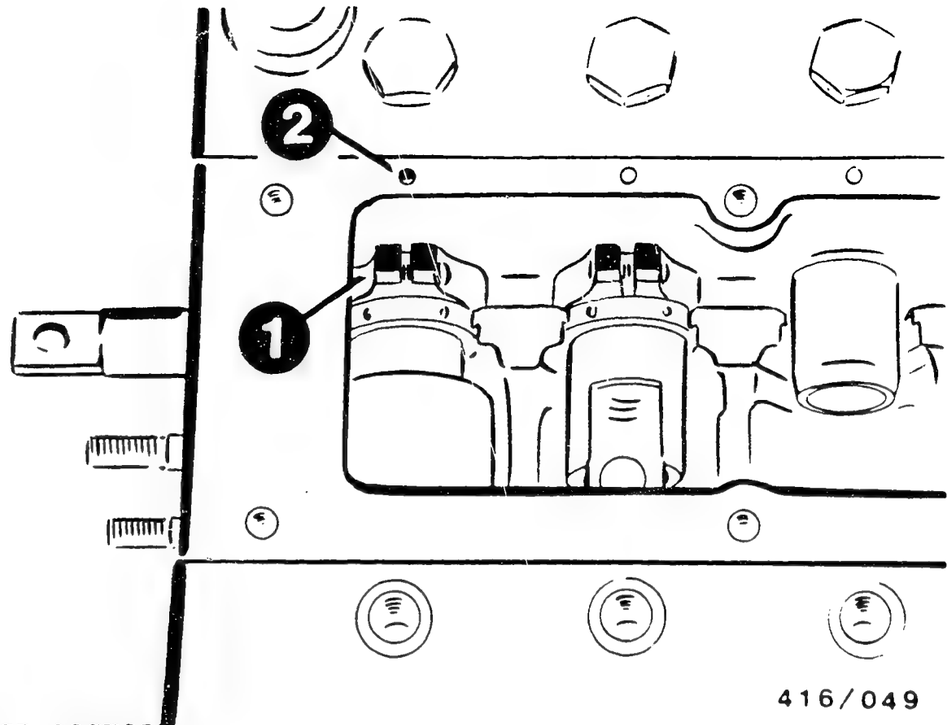
416/045

Remove compressed-air connection at pump housing.

Clamp on and tilt pump housing.

Remove screws.

Use plunger grippers KDEP 2942 to remove pump plunger from pump barrel and place it in respective barrel-assembly tray.



416/049

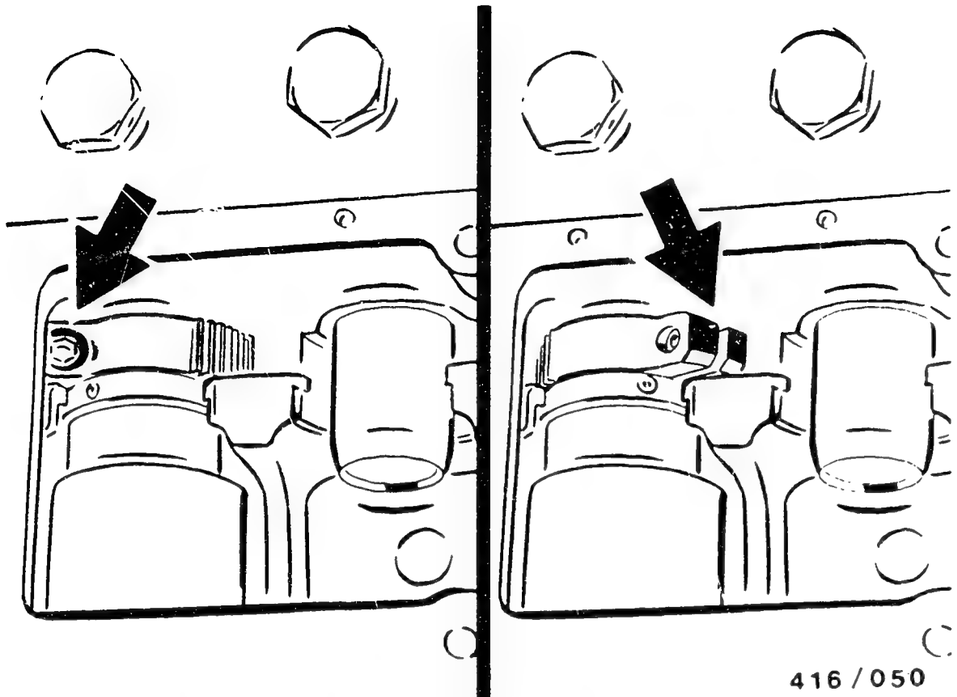
1 = Gear segment
2 = Positioning pin

Fitting control rod and control sleeves

Insert control rod into pump housing. Screw in positioning screw (series up to 2999), tighten to 5...6 Nm and secure.

Move control rod to center position.

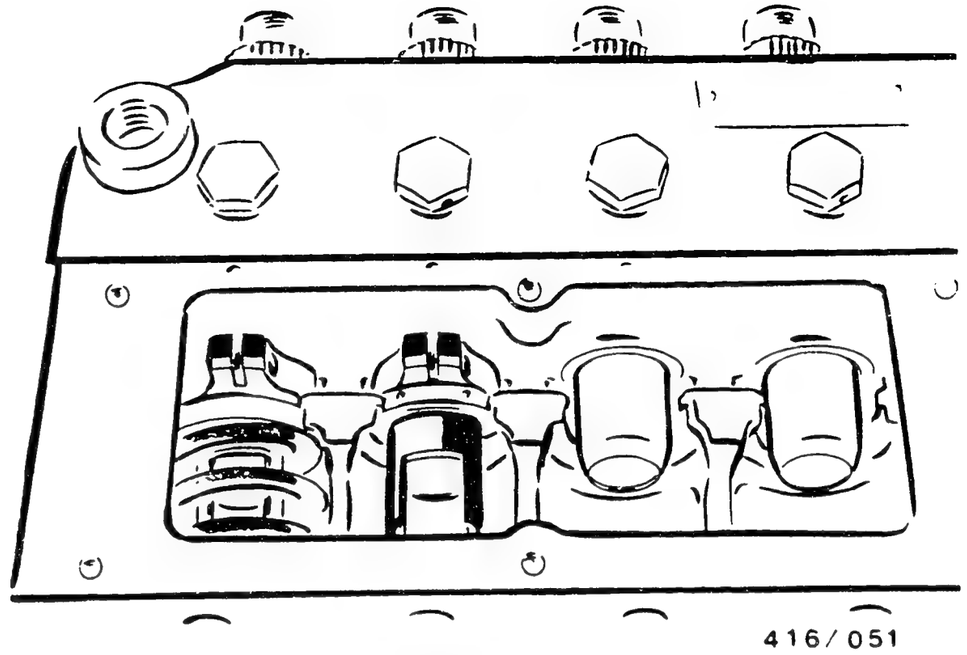
Using mounting tool KDEP 1652, insert control sleeve with gear segment into control rod such that gear segment is in alignment with positioning pin of pump barrel.



416/050

Actuate control rod from stop to stop and check whether clamping jaw of gear segment is the same distance from housing collar (picture, arrows) in both end positions.
If this is not the case, move control rod to center position and fit control sleeve again.

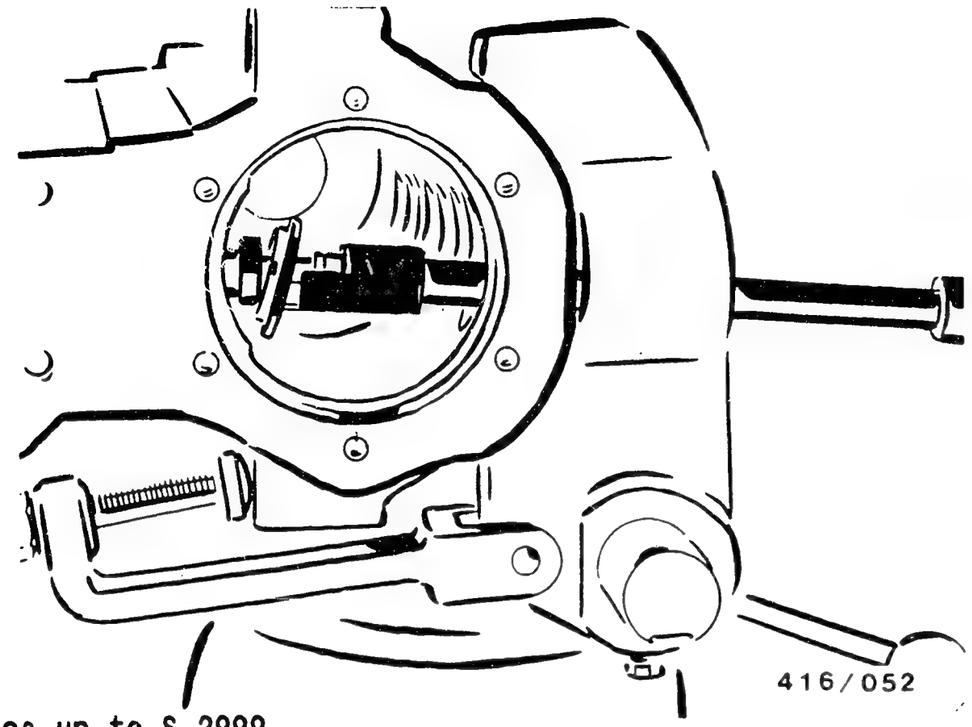
Insert remaining control sleeves in same position.
Then check all gear segments for same left-hand and right-hand stop.



416/051

Fit pump plunger and roller tappet.

Install upper spring seat and plunger return spring.



Series up to S 2999

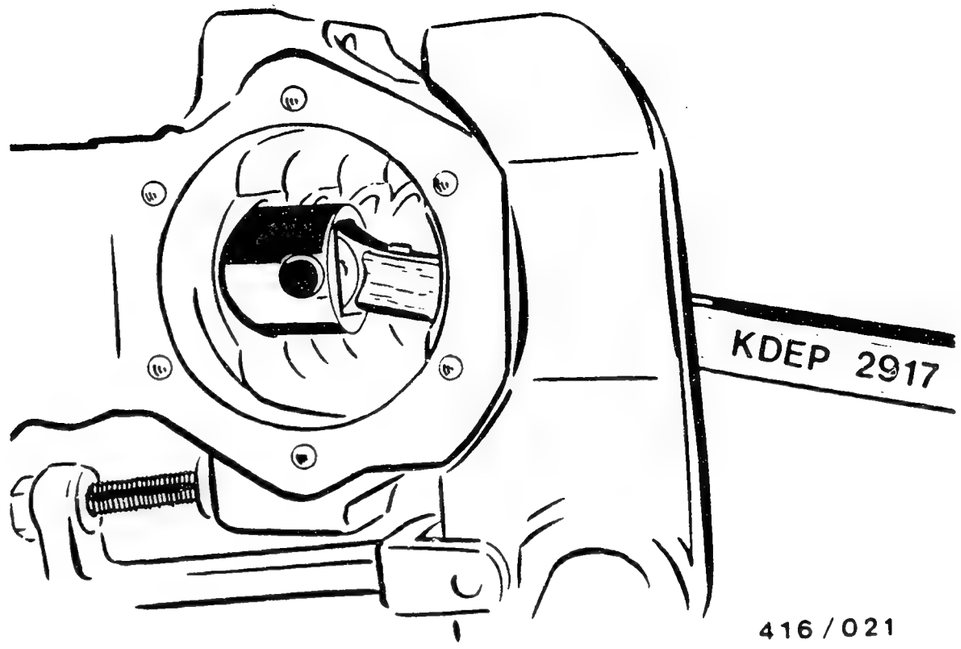
Moisten pump plunger with calibrating oil and install with plunger grippers KDEP 1623 and lower spring seat in pump barrel.

Series as of S 3000

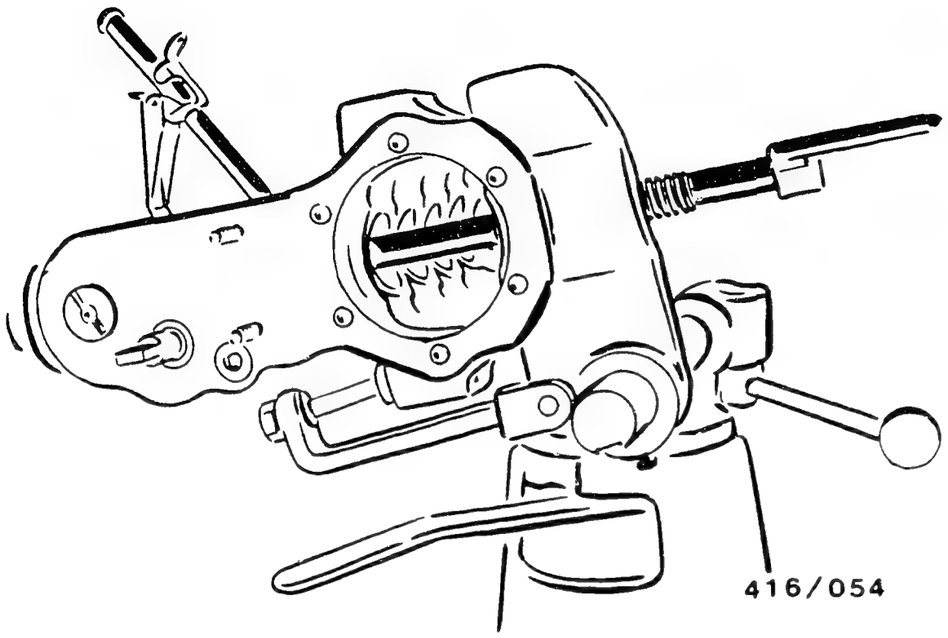
Moisten pump plunger with calibrating oil and insert with plunger grippers KDEP 2942 and lower spring seat in pump barrel.

Check pump plunger for freedom of movement.

Note:
The index notch on the plunger control arm must point upwards towards the spring-chamber closing cover on insertion.

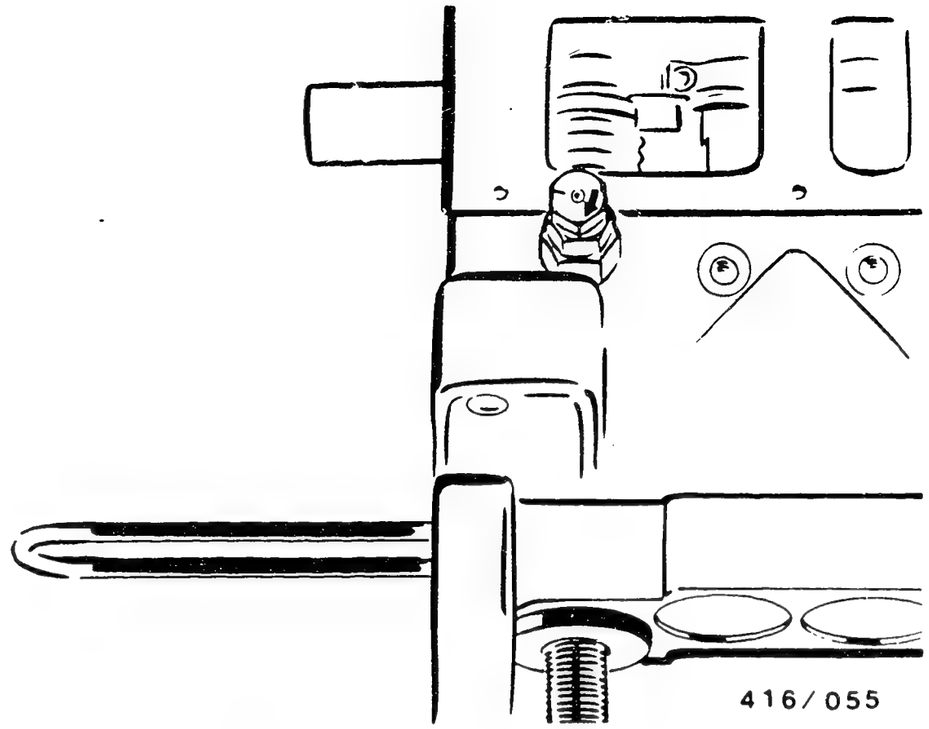


Insert roller tappet with tappet forceps KDEP 2917 into camshaft chamber. Guide groove in roller-tappet shell must face upwards.



Series up to S 2999

Use clamping fixture KDEP 1536 to press roller tappet against plunger return spring and fix in upper position with tappet holder KDEP 1621.



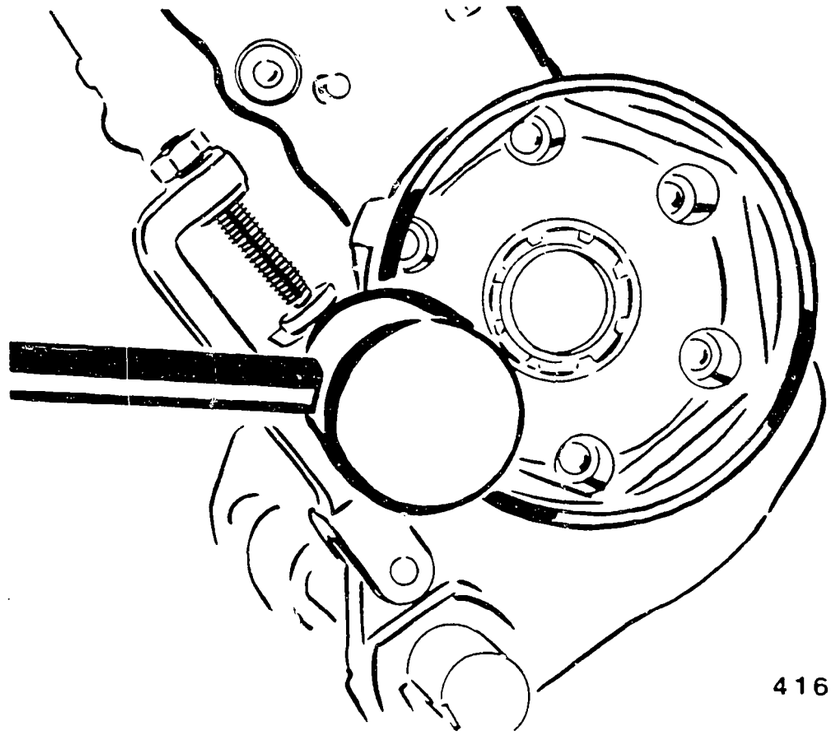
Series as of S 3000

Use clamping fixture KDEP 1535 to press roller tappet against plunger return spring until hole in guide groove in tapped hole is visible. Fix plunger holder KDEP 1534 in upper position.

Loosen lock nut at plunger holder such that contact surface of eccentric makes contact with end of thread.

Screw in plunger holder ensuring that mark on drive hexagon points vertically downwards. Tighten plunger holder.

Move drive hexagon approx. 1/4 of a turn in direction of arrow until roller tappet has lifted off clamping fixture (Caution! Turning the eccentric too far damages tool and roller tappet).



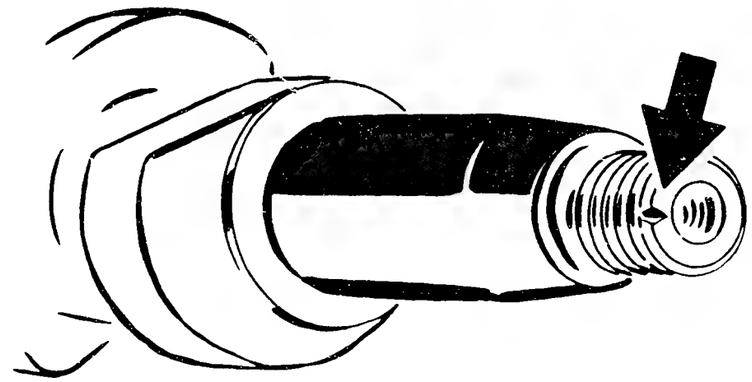
416/056

Camshaf+ installation

Apply a small quantity of grease to O-ring on drive-bearing end plate.

Drive bearing end plate into housing using plastic hammer.

Tighten fastening screws with tightening torque of 15...18 Nm (M6)or 20...24 Nm (M8).



410/135

Before fitting camshaft, pay attention to index notch which is only to be found on one side of the two threaded shaft ends (picture, arrow).

The installation position of the mark determines the correct cam sequence and can be seen from the assembly number of the fuel-injection pump.

Note:
In the case of differing cone diameters, the larger diameter faces the drive end.

Explanation of assembly numbers

Supply pump (attachment side and number)														Governor on pump side 1)	Timing device on pump side	Plunger helix	
		Attached to: Pump side 3				Pump side 4				Pump sides 3 and 4							
Without		1 x		2 x		1 x		2 x		1 x		2 x					
Shaft position (indicated by notch at shaft end)																	
1	2	1	2	1	2	1	2	1	2	1	2	1	2			Lower	Upper
100	200	300	400	500	600	700	800	900	1000					–	–		
101	201	301	401	501	601	701	801	901	1001					–	1		
102	202	302	402	502	602									–	2	left-hand	right-hand
110	210	310	410	510	610									1	–		
112	212	312	412	512	612									1	2		
120	220	320	420	520	620	720	820	920	1020	1320		1520		2	–	right-hand	left-hand
121	221	321	421	521	621	721	821	921	1021					2	1		

Example: 421

Fuel-injection pump with shaft position 2 and supply pump on pump side 3, governor on pump side 2 and timing device on pump side 1.

A code number for the supply-pump attachment possibility can be added on to the assembly number, e.g.:
../3 = with attachment hole for supply pump, sealed by means of cover (without supply pump).

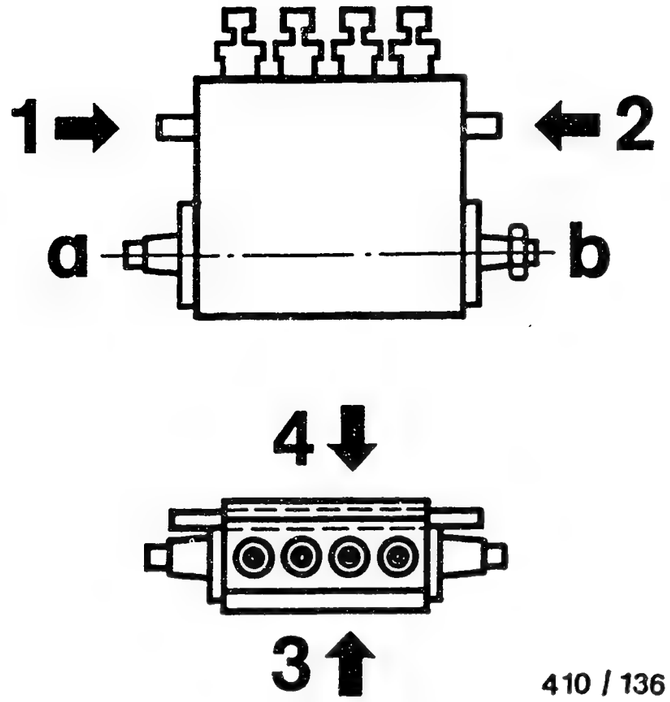
../4 = with 2 attachment holes, left hole sealed with supply pump and right hole with cover.

../5 = with 2 attachment holes, left hole sealed with cover and right hole with supply pump.

../6 = with 2 attachment holes, both covers sealed (without supply pump).

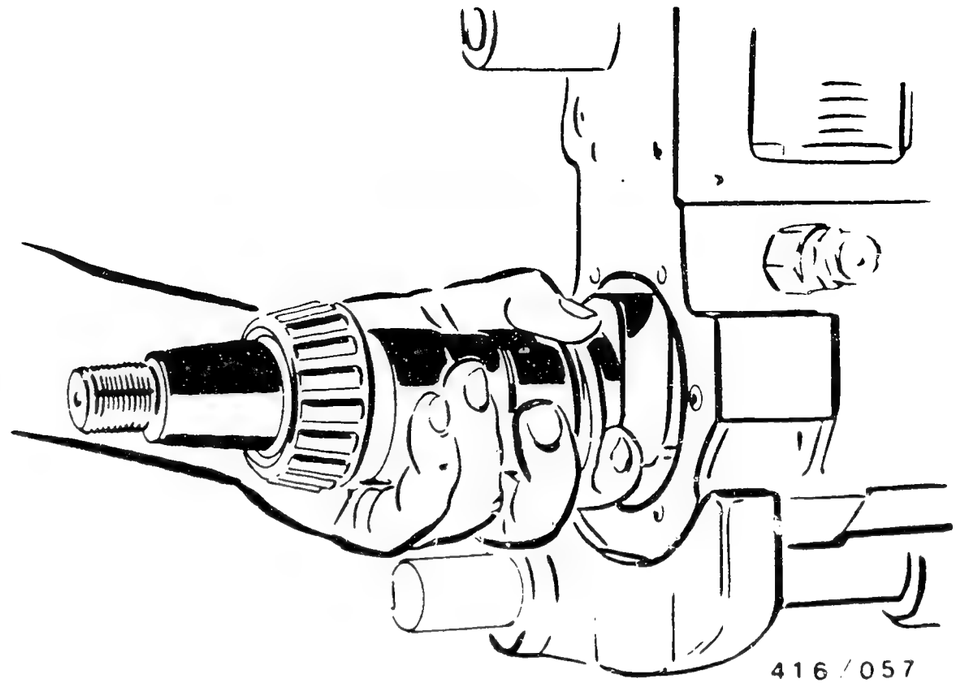
../7 = with 2 attachment holes each on sides 3 and 4, right-hand attachment hole sealed with cover.

1) The entire injection-pump assembly is turned through 180° in the case of assembly numbers starting with uneven numbers (300,500,700 etc.) with governor position 2.



410 / 136

3,4 = Pump side if cover at front and control rod at back
a = Shaft position 1 (notch at shaft end)
b = Shaft position 2 (notch at shaft end)



416 / 057

Insert camshaft with intermediate bearing into camshaft chamber.

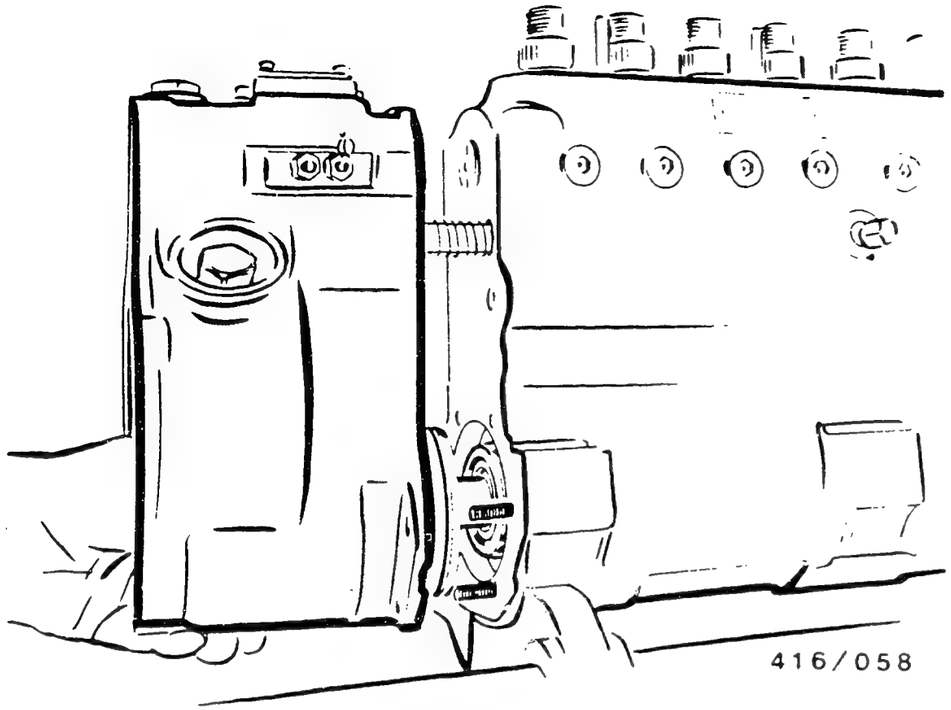
N O T E :

In order to avoid damage to radial-lip-type oil seals when fitting camshaft, use mounting sleeve in line with cone diameter.

Cone dia. 25 mm, mounting sleeve KDEP 2925
Cone dia. 30 mm, mounting sleeve KDEP 1502
Cone dia. 35 mm, mounting sleeve KDEP 2869

6/ 8 barrel fuel-injection pumps have 1 intermediate bearing.

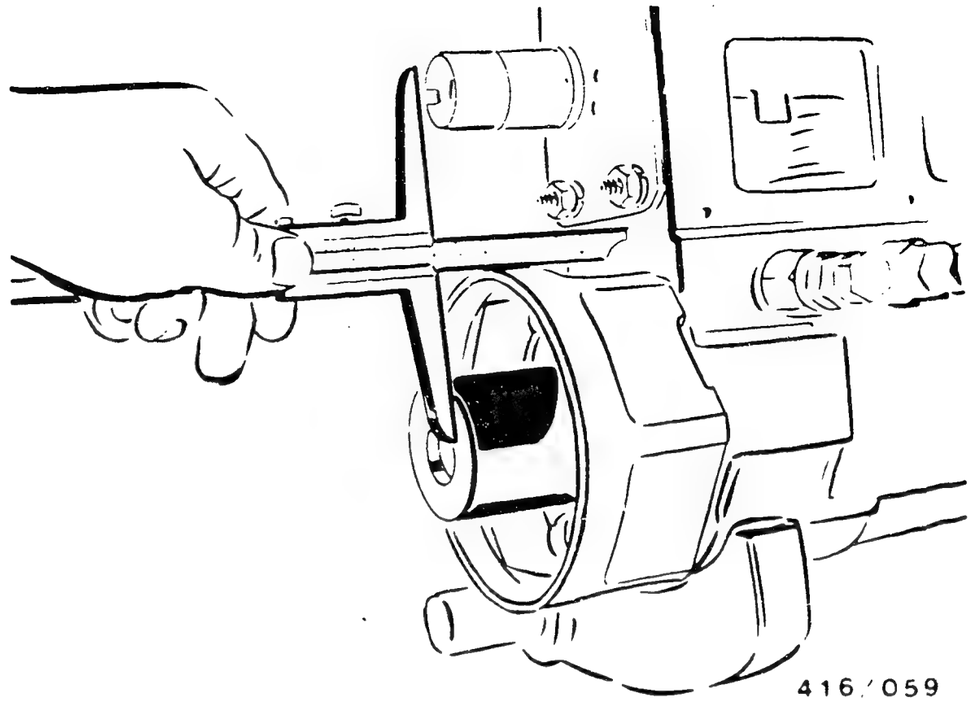
10/12 barrel fuel-injection pumps have 2 intermediate bearings.



Position pump housing such that it is vertical.

Fit governor housing with new seal.
Tighten fastening screws of governor housing employing corresponding tightening torque.

Flat-head screw	13...18 Nm
Hexagon bolt	11...16 Nm
Hexagon nut	11...16 Nm
Capstan screw	5...7 Nm



Testing and adjustment of projection and axial clearance of camshaft

Slip measuring tool on to camshaft cone.

Cone diameter 30 mm	KDEP 1656
Cone diameter 35 mm	KDEP 1657

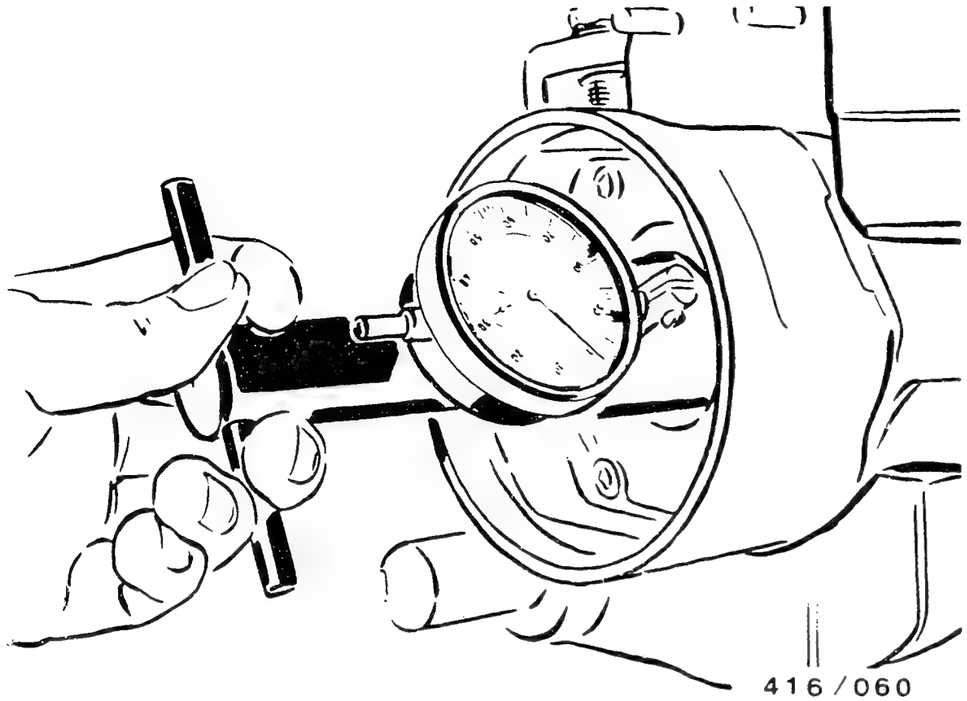
Use depth gauge to determine distance between top edge of measuring tool and pump housing and note down distance.

Set values:

Cone diameter 30 mm	90 +/-0.2 mm
Cone diameter 35 mm	90 +/-0.2 mm

Projection is adjusted by way of shims beneath camshaft bearing.

Note:
The axial clearance of the camshaft is likewise adjusted with the same shims.



Testing axial clearance of camshaft

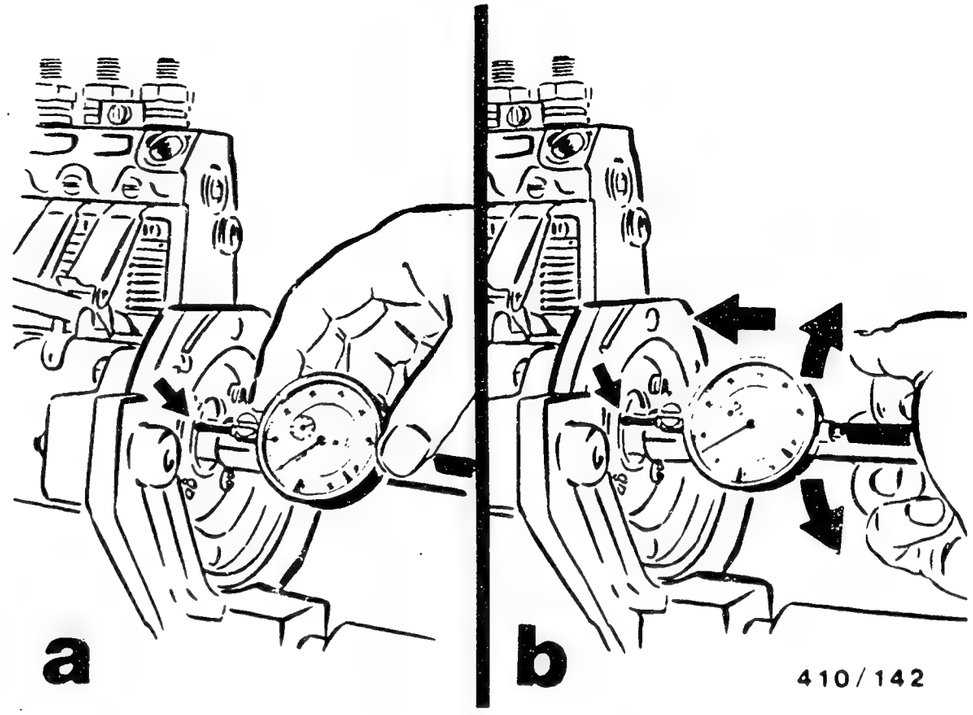
Screw on axial-clearance measuring tool (in line with cone diameter of camshaft) on drive end.

Insert dial indicator into holder provided and pre-tension by approx. 5 mm.

N O T E :

Measuring tool:
KDEP 2882 for cone diameter 30 mm
KDEP 2889 for cone diameter 35 mm

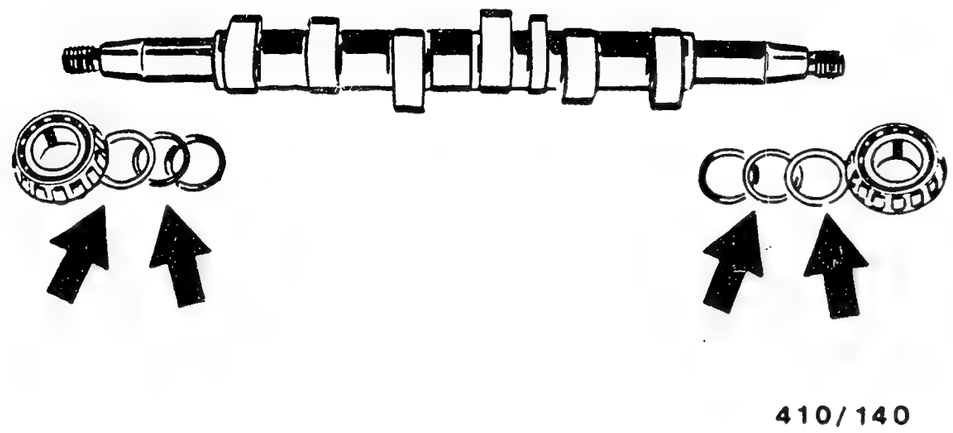
Axially tension camshaft with measuring tool employing brief, rapid turning motion (approx. 45°).



Release measuring tool.
Set dial indicator to "0" (picture a).

Then, employing same turning motion, axially compress camshaft and release at same point at which dial indicator was set to "0" (white arrows, pictures a and b).

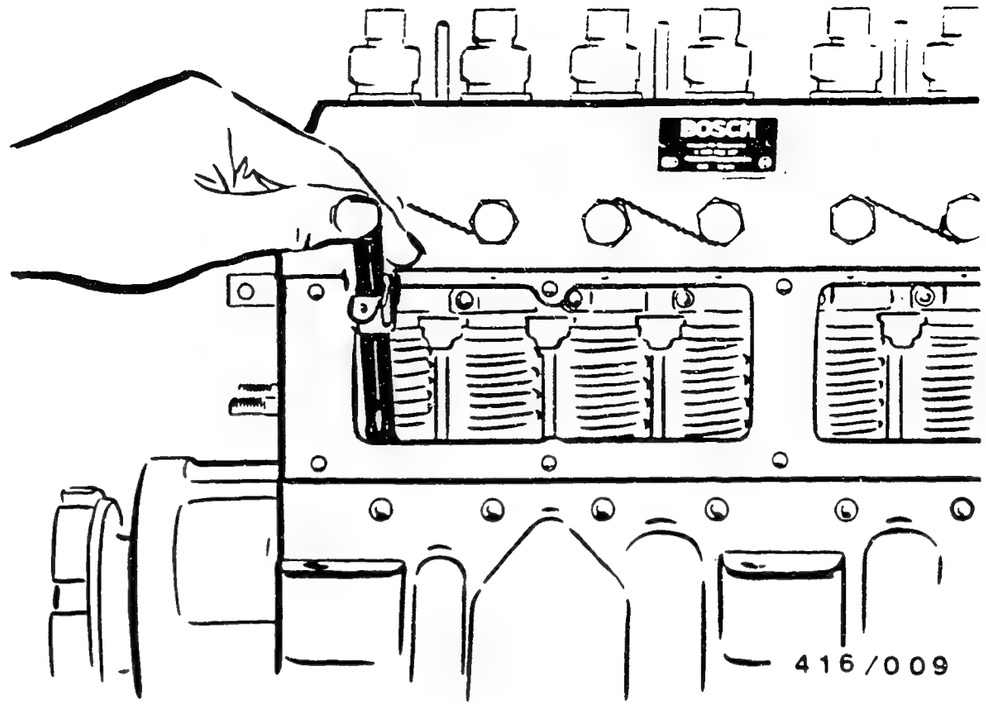
Read off axial clearance on dial indicator:
Set value: 0.02...0.06 mm



410/140

If the measured values for projection and axial clearance are outside the tolerance range, remove camshaft, press off camshaft bearing and adjust projection and/or axial clearance by changing shims (picture, arrows).

Repeat projection and axial-clearance tests.



416/009

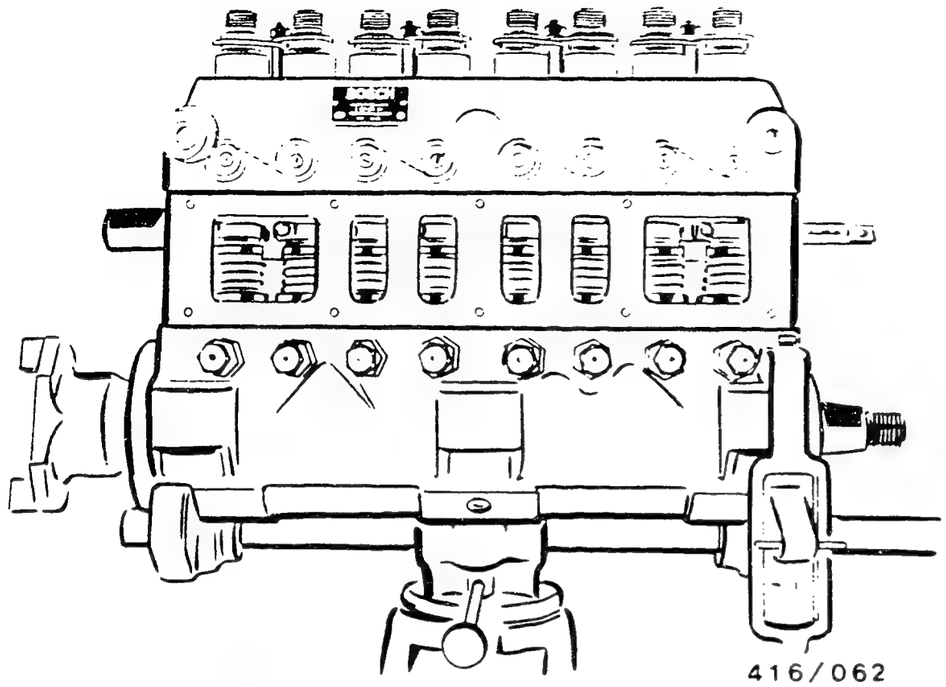
Series up to S 2999

Attach driving coupling in line with cone diameter of camshaft and tighten it (counter-hold with holding wrench).
Turn camshaft and remove tappet holder in TDC position of respective cam.
Attention is to be paid to ease of removal of tappet holder from roller-tappet hole. Removal of the tappet holder by force damages the roller tappet and tappet holder.

Check to see that control rod moves freely.

Tilt fuel-injection pump.

Note:
If control rod does not move freely, check radial clearance of control sleeve.



416/062

Series rs of S 3000

Attach driving coupling in line with cone diameter of camshaft and tighten it (counter-hold with holding wrench).
Turn camshaft and remove tappet holder in TDC position of respective cam.

Loosen lock nut at tappet holder and unscrew approx. 3 turns.
Turn drive hexagon against direction of arrow until line marking is vertical at bottom.

Move camshaft back and forth in TDC position using holding wrench until cam position is reached in which the drive hexagon of the tappet holder can be easily moved by hand.

Loosen tappet holder and remove from pump housing.
Screw in guide screws and tighten employing tightening torque of 17...20 Nm.

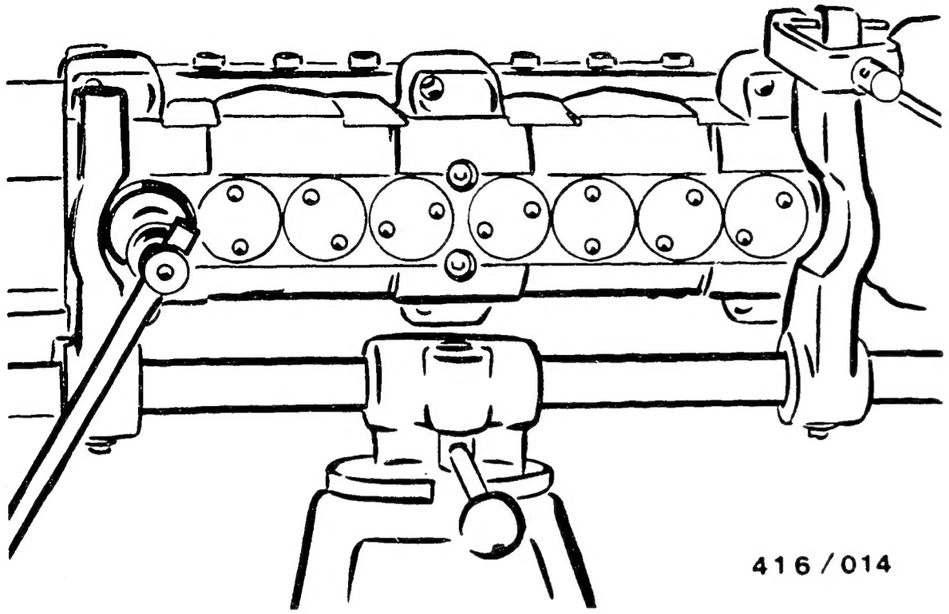
Check freedom of movement of control rod.

Tilt fuel-injection pump.

Note:
If control rod does not move freely, check radial clearance of control sleeve.

Basic adjustment of the fuel-injection pump is to be carried out before performing the work outlined below.
The camshaft is to be removed in order to be able to effect correction of the basic adjustment on fuel-injection pumps as of S 3000.

Note:
If the fuel-injection pump is not adjusted immediately, continue with assembly (see Coordinate D25/D26).

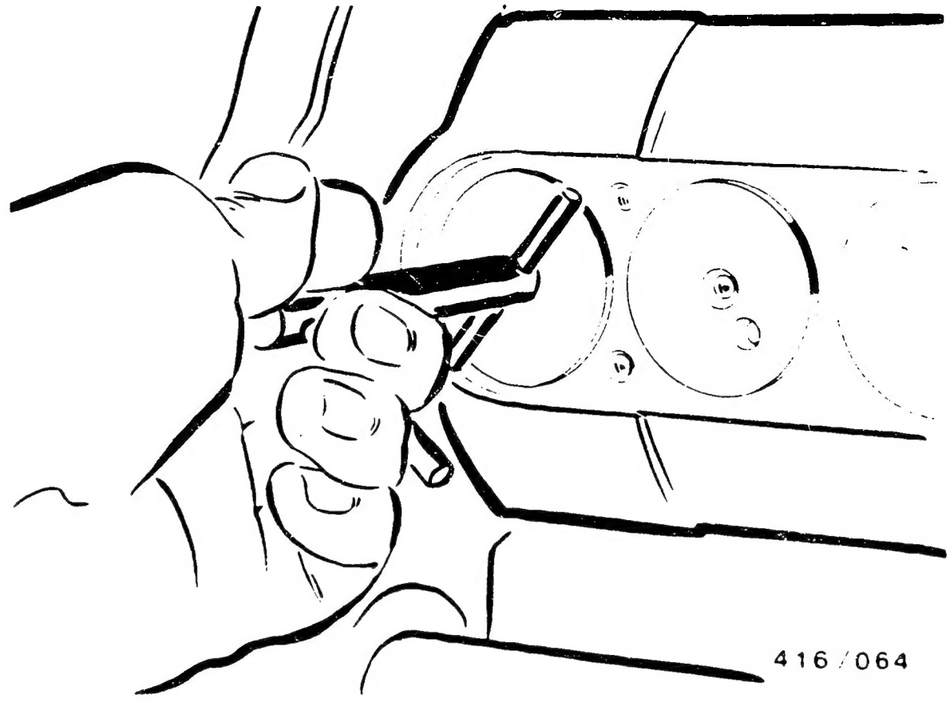


Fitting base cover

Fit fastening screws of intermediate bearing with O-rings and tighten employing tightening torque of 20...24 Nm.

Series up to S 2999

Screw in base cover and tighten with screwing tool KDEP 1072.
Tightening torque: 110...120 Nm



Series as of S 3000

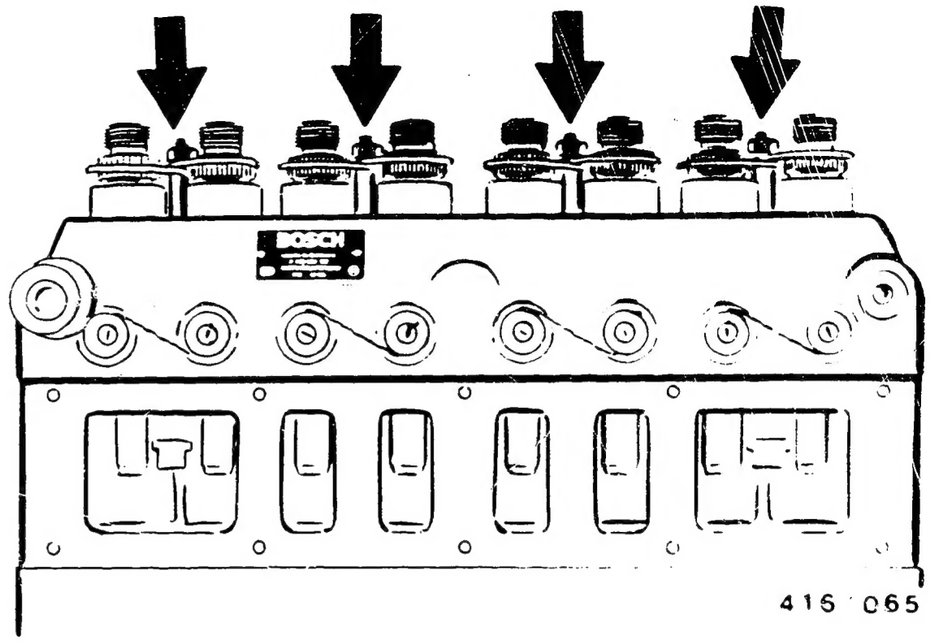
Fit base cover with mounting tool KDEP 1651.
Fit tab washer with flat-head screws.
Tightening torque: 4...5 Nm.

Pre-assemble control rod with spring, spring seat and hexagon bolt.

Assemble governor in accordance with respective repair instructions.

Only fit supply pump and spring-chamber closing cover following adjustment on injection-pump test bench.

Unclamp fuel-injection pump.



Fit straps at delivery-valve holders (picture, arrows).
Tighten nuts with tightening torque 11...15 Nm.

Leak test on camshaft, spring and governor chambers

Completely assemble fuel-injection pump.
The compressed air required for the leak test is to be supplied to the pump camshaft chamber at a suitable point.
Immerse fuel-injection pump vertically into test bath.

Test duration and test pressure:
30 min. at 5 bar, then
30 min. at 0.5 bar.

Establish by means of visual inspection whether all sealing surfaces, screw connections, seal rings and end covers are leakproof at housing and pump cover. There must be no air bubbles.

In order to avoid skin irritation, apply hand-cream beforehand and wash hands in soap and water after completion of testing.

For production reasons:
continued on the following coordinate.

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